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MEMORANDUM

ATTENTION	Senate	**DATE**	November 18, 2021
FROM	Wade Parkhouse, Associate Vice-President, Academic and Vice-Provost and Chair, SCUP	**PAGES**	1 of 1
RE:	Full Program Proposal for a Master of Science in Professional Visual Computing (SCUP 21-40)		

At its November 17th, 2021 meeting, SCUP reviewed and approved the Full Program Proposal for a Master of Science in Professional Visual Computing in the School of Computing Science within the Faculty of Applied Sciences.

Motion:
That Senate approve and recommend to the Board of Governors the Full Program Proposal for a Master of Science in Professional Visual Computing in the School of Computing Science within the Faculty of Applied Sciences, effective Spring 2023 or later.

For Information:
Included with the full program proposal and approved by SGSC subject to approval by Senate:

1) New calendar entry: Master of Science in Professional Visual Computing

C: J. Wang, A. Mahdavi-Amiri

SFU GRADUATE AND POSTDOCTORAL STUDIES

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MEMORANDUM

ATTENTION Senate Committee on University Priorities (SCUP)

DATE November 3, 2021

FROM Jeff Derksen,
Chair of Senate Graduate Studies Committee (SGSC)

RE: Full program proposal: Master of Science in Professional Visual Computing

For approval:
At its meeting on October 4, 2021, SGSC approved the full program proposal for a Master of Science in Professional Visual Computing from the Faculty of Applied Sciences. SGSC is recommending it to SCUP for approval, effective **Spring 2023.**

Motion:
That SCUP approve and recommend to Senate the full program proposal for a Master of Science in Professional Visual Computing from the Faculty of Applied Sciences effective **Spring 2023**.

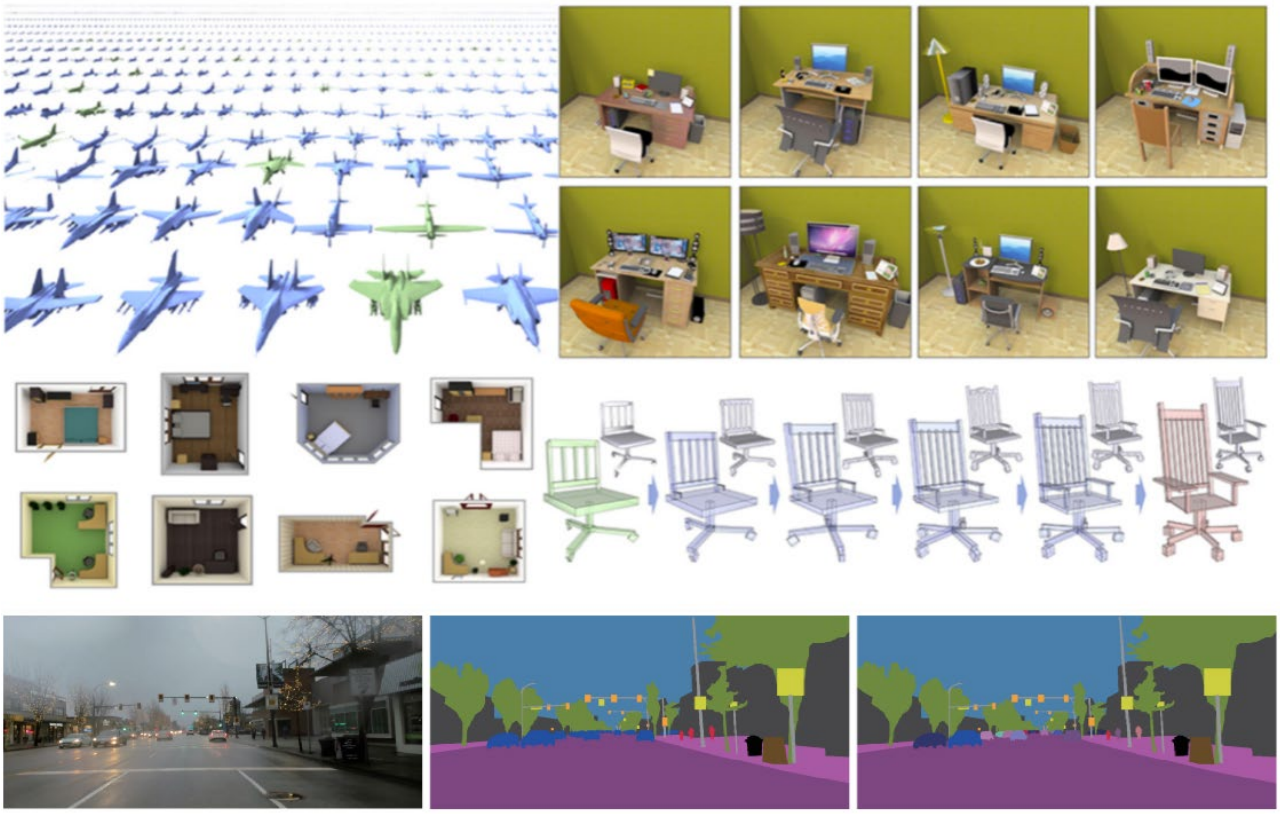
For Information:
Included with the full program proposal and approved by SGSC subject to approval by Senate:

1) New calendar entry: Master of Science in Professional Visual Computing

SIMON FRASER UNIVERSITY
ENGAGING THE WORLD

Professional Visual Computing

Full Program Proposal



November 22, 2021

School of Computing Science

Faculty of Applied Sciences

SUMMARY

Simon Fraser University is defined by its dynamic integration of innovative education, cutting-edge research and far-reaching community engagement. SFU was founded in 1965 with a mission to bring an intradisciplinary approach to learning, embrace bold initiatives, and engage with communities near and far. Today SFU is consistently ranked amongst Canada's top comprehensive universities and is one of the world's leading teaching and research institutions.

The School of Computing Science proposes the creation of a "Professional Visual Computing" program. It will be a unique professional intradisciplinary program in visual computing conceived in close collaboration with leading industry partners and government organizations. Students will acquire the technical background knowledge and practical skills needed to meet the province's growing demand for visual computing professionals. These skills include advanced topics such as deep learning, computer vision, and computer graphics, and they will be provided to the students through several meticulously developed technical and hands-on courses. SFU has a high-quality, diverse set of faculty members focused on visual computing that makes the program unique in Canada and BC.

The program will align with and reinforce SFU's strategic academic plans. Moreover, it reinforces the Province of British Columbia's commitment to stimulate industry-focused programs that support high demand occupations in the province's technology sector. The visual computing market was valued at US$14.812 billion in 2017 and is projected to expand at a compound annual growth rate of about 18% to reach almost US$40 billion by 2025[1],[2]. Visual computing related industry in Canada is also growing very fast and requires experts that can fulfill this need. In Vancouver alone, over 60 studios make up the VFX and animation industry, making it the world's largest cluster of domestic and foreign-owned studios[3]. There are several other areas and sectors that can benefit from our program including game companies, AR/VR, autonomous driving, modern agriculture, etc. As a result, we expect that our graduates will be hired by the industry very quickly and will become leaders in these areas benefiting Canada's economy and society.

[1] https://www.marketsandmarkets.com/Market-Reports/visual-computing-market-157021061.html
[2] https://www.marketwatch.com/press-release/visual-computing-market-2021-top-countries-data-with-market-size-comprehensive-research-methodology-regional-study-and-business-operation-data-analysis-by-2025-2021-06-09
[3] https://www.vancouvereconomic.com/vfx-animation/

1) Proposed credential to be awarded

Master of Science

2) Location of program

The Professional Visual Computing Program will be offered at SFU Burnaby.

3) Academic unit(s) offering proposed program

School of Computing Science in the Faculty of Applied Sciences

4) Anticipated program start date

January 1, 2023

5) Anticipated completion time

It is anticipated that the program will typically be completed in 4-5 terms (16 or 20 months). The duration depends on whether the students take a four or eight-month co-op / industrial internship placement during their study.

6) Contact information

Dr. Jiannan Wang, Associate Professor and Program Director, 778-782-4288, jnwang@sfu.ca

Dr. Richard Zhang, Professor in Visual Computing, 778-782-6843, haoz@sfu.ca

Dr. Ali Mahdavi Amiri, Assistant Professor of Professional Practice, 604-202-1156, amahdavi@sfu.ca

PROGRAM DETAILS

7) Aims, goals and/or objectives of the proposed program

This program aims to address the talent gap in the area of visual computing and related information technology sectors. It trains experts and engineers in visual computing related fields (e.g., computer vision) who apply a deep knowledge of computer science to develop cutting-edge tools, stimulate product innovation, and explore new technology fronts in all commercial, engineering, and creative professions. Such a program is needed in the area of visual computing since a bachelor's degree is not sufficient to train students to become experts in this area. In fact, becoming an expert in visual computing requires highly technical knowledge in various aspects including computer vision, computer graphics, and deep learning for which a bachelor's degree in computer science or a related field is a pre-requisite.

In this program, students will be well-prepared to become software developers and architects in areas including computer graphics, computer vision, deep learning, image processing, AR/VR, and computer-aided design and manufacturing. The final goal of this program is to train technical leaders and experts in the rapidly growing area of visual computing that can help Canada's economy. It is also expected to become the best and most specialized master's program in the area of visual computing considering our outstanding faculty members that perform top-notch research and industrial collaborations in this field. The curriculum will focus on topics and practices that are in high demand and applicable in the industry (e.g., deep learning, computer vision) by offering relevant hands-on courses and mandatory internships.

Visual computing is an intradisciplinary field of study and research with applications in many different areas including manufacturing, autonomous driving, gaming, etc. Our proposed graduate degree program promotes experiential learning through unique hands-on training in visual computing concepts, appropriate tools, and related applications. For this reason, the well-rounded curriculum focuses on visual computing skills such as computer graphics, computer vision, game programming, deep learning, etc. Additional elective courses in machine learning, natural language processing, computer animation, and geometric modeling further broaden the scope. Intensive lab courses built on practical aspects of visual computing are developed based on the topics needed in industry. Such topics have been collected in consultation with local and international companies such as Electronic Arts, Terramera, IBM, MetaOptima, etc.

Technical training provided in classrooms and laboratories will also be paired with practical experience through an industrial internship or co-op program of at least four months, working with external partner organizations in industry, and government. This way, the program prepares graduates for working in a wide range of sectors in need of visual computing expertise and skills and expedites their absorption into the job market. Graduates from this program can expect to easily find well-paid jobs right now and even more so in the future.

8) How does the proposed program fit within the mandate of the institution?

The new program supports SFU's mandate to integrate innovative education and cutting-edge research, especially in the area of visual computing for which our faculty has been highly awarded. The proposed visual computing program is a direct outcome of the Faculty of Applied Sciences (FAS) Academic Plan 2019-2024[4], which outlines expansion and diversification of professional graduate programs "which provides an increased range of opportunities for our students upon graduation." Modern visual computing is also heavily involved with AI and machine learning related

[4] https://www.sfu.ca/content/dam/sfu/vpacademic/files/vp_academic_docs/pdfs/AppliedSciences2019-2024.pdf

topics such as deep learning in computer vision, autonomous driving, deep geometry processing, etc. As a result, our program is well aligned with FAS' priorities.

SFU visual computing research program and faculty ranks among the highest caliber programs and faculties in Canada and around the world. According to the global university ranking (CSRanking) in computer science, the School of Computing Science at Simon Fraser University is among the top 15 schools in visual computing in terms of research. The School of Computing Science has more than ten faculty members who perform high quality visual computing related research and engage indirectly relevant industry collaborations.

9) How does the proposed program support the current academic and strategic plan of the institution?

This new program supports the challenges as identified in SFU's Five-Year Academic Plan in the following ways[5]:

- Student life, learning and success: our faculty and staff have extensive expertise in the area and will ensure students have the best possible learning experience.
- Academic quality: because of our existing resources in visual computing, we will be able to offer exceptional education while also meeting diverse student needs.
- Engagement: the size of the new program and the staff support we have available will allow us to engage with our students on a regular basis through personal advising, info sessions and events.
  By offering this new program we will also help solve a range of problems arising in industry and communities using knowledge in deep learning, machine learning and visual computing.
- Bridging divides: this is supported by the involvement of other Faculties as instructors or member(s) in our steering committee.
- Faculty and staff renewal: as previously mentioned, the School of Computing Science is home to excellent faculty and research in the area of visual computing which will ensure outstanding learning opportunities are available to our students. The School is also committed to hiring and training high quality personnel to support our program.
- Creative technologies: the program also contributes to SFU's strategic interest in capitalizing on opportunities and needs to advance innovation and exciting academic programming, especially in creative technologies with a special focus on professional degrees at the master's level.

10) Target Audience

[5] Five-Year Academic Plan 2019-2024, Simon Fraser University, November 2018 [Online].

The target audience consists of recent graduates and working professionals who hold a bachelor's degree in computer science or a related field and wish to upgrade their education with a visual computing graduate degree. For some, the motivation might be a career change, while for others, especially those who are already working in a position that deals with computer graphics, computer vision, or human-computer interaction, it may be the prospect of a promotion or consideration for management opportunities down the road.

As the program would be offered face-to-face, our target audience is looking for a typical university environment with its opportunities for thought exchange, extracurricular activities, and networking on campus, rather than a technical institute or an online program.

11) Related programs in the institution or other British Columbia post-secondary institutions and outside of British Columbia

There are no similar programs offered by Canadian institutions at the time of this writing. Programs that are somewhat similar are traditional research-based master's degrees allowing students to specialize in one of the various areas of computer science. However, we have not encountered any professional course-based master's programs that specifically focus on applied visual computing skills as our proposed master's program would.

For example, SFU's School of Interactive Arts and Technology (SIAT) offers a Master of Science wherein students learn about designing, making, and using human-centered technologies. However, our proposed program focuses on rigorous techniques and algorithms related to visual computing and trains engineers that will be experts in computer vision, computer graphics, image processing, and deep learning. These topics are completely different from the contents provided in SIAT's program. In addition, the SIAT's program is research-based requiring the completion of a thesis and does not cover the many other aspects that our proposed program would include such as the mandatory co-op that prepares students for the job market.

The Master of Digital Media (CIP 50.0401) program co-offered by the University of British Columbia, Simon Fraser University, Emily Carr University of Art and Design, and the British Columbia Institute of Technology is slightly similar to our proposed program in terms of duration, and structure, but its content and target audience are totally different. While MDM focuses on training visual content designers, our program focuses on training engineers and experts that have backgrounds in mathematical concepts and algorithms related to visual computing, computer vision, computer graphics, machine learning, and deep learning. These topics are not covered in the MDM program as its focus is on social aspects of visual content. Therefore, the two programs are different in content, job markets, and audience. So, our proposed program would not be considered a duplication. We elaborate on the programs' differences in the subsequent section.

Northeastern program has a thesis-based program (Electrical and Computer Engineering with Concentration in Computer Vision, Machine Learning, and Algorithms) with similar courses.

However, Northeastern's program is structurally quite different from our proposed program. First, Northeastern's program is quite a bit longer in duration (by 8-16 months), it offers additional delivery modes (online and hybrid) and includes an optional co-op rather than a mandatory one. It also does not offer the two hands-on lab courses that we offer in our program to prepare students for applied industry related tools and concepts.

12) What differentiates the proposed program from all other related programs in the province?

There are no other similar master's programs that deal with visual computing in the province or even in the country (yet). Although there are thesis-based master's degrees allowing students to study under a visual computing research faculty, such programs typically differ from our proposed program in their nature and duration. These programs tend to be longer than our proposed program, and they focus on research skills, requiring students to complete a thesis or project subject to a formal examination by a supervisory committee. Such programs often serve to prepare students for research-focused careers or further study at the doctorate level. As such, they typically lack the applied lab work that our program would offer as well as the industry experience provided via the mandatory co-op / industrial internship.

The Master of Digital Media (MDM) program mentioned in the previous section differs from our proposed program in multiple ways. Most notably, the MDM course content deals with social and creative aspects of digital media, for example the history of digital media and its role in society, visual storytelling, creative improvisation within a team environment, and principles of interactive game design. Its aim is to train students in the digital design process with a strong focus on project management competencies such as self-awareness, time management, communication and literacy skills, and teamwork. Our proposed program, on the other hand, deals with the mathematical and computational underpinnings of computer graphics, computer vision, animation, and other visual applications of computer science. Our program trains technical personnel in the acquisition, analysis, manipulation, and creation of 2D or 3D visual content. MDM graduates typically work in media management/director or designer/artist positions, whereas alumni of our proposed program would hold software development, computer engineering, and data analysis roles specializing in one of the many sub-disciplines within visual computing (e.g., computer vision, imaging sciences, virtual reality, computer-aided design and manufacturing, etc.). As mentioned in the support letter from David Fracchia (see Appendix 3), Professor of Professional Practice at the Centre for Digital Media, our proposed program differs significantly from the MDM, which is "multidisciplinary, with students whose undergraduate backgrounds include art, design, management, and software development, and is focused on developing essential communication, collaboration & leadership skills with an emphasis on experiential learning through project courses." It is important to note that Fracchia's letter was endorsed by the director of the MDM, who is the most instrumental member of the program's leadership team.

13) An overview of the level of support and recognition from other post-secondary institutions, and relevant regulatory or professional bodies

There are many Canadian and foreign companies in Canada that are actively working on different branches of visual computing including computer vision, computer graphics, computational fabrication, and computer games. We have had discussions with several industry partners including Electronic Arts, Terramera, OneCup AI, and IBM among others, and we observed that all of them are keen to hire highly qualified personnel proficient in visual computing. Given the accelerated pace of this program, it is not designed as one for which there are many opportunities to transfer to other programs within the British Columbia post-secondary education system. However, students could request to have a limited number of graduate courses taken elsewhere to be considered regarding the unit requirements of the proposed degree (as is the case for other graduate programs).

The Program will not require the approval of any external regulatory or professional bodies in the area of computer science to show the level of support and recognition for the program.

To highlight the level of support and recognition from other post-secondary institutions, we have collected and included letters of support from well-known universities available in Appendix 3.

14) What added value will the proposed program offer graduates in terms of employment opportunities?

Students will benefit from a focused program on visual computing and take courses that are designed to train visual computing experts. Along with the high-quality visual computing courses that are available to all graduate students in the school, two six-unit lab courses are mandatory for students in this program that provide hands-on experiences on fundamental and state-of-the-art visual computing techniques. In addition, students in this program must take a four- or eight-month co-op / industrial internship that gives them the opportunity to learn about the job market and work on problems that industries are trying to overcome. There are many large and small companies in BC that are trying to hire talent trained in the area of visual computing. These companies work on a variety of topics related to visual computing including AR/VR, agriculture, computer vision, autonomous driving, aviation, etc. Considering the strong collaboration of our faculty members with these industries, students can take advantage of this already built-up relationship and they can enter the market faster and more efficiently. Specifically, the program focuses on the application of deep learning in visual computing. Computer vision, computer graphics, and deep learning are sought-after skills in the job market with a high average salary - our students will be well-trained in these areas (See Appendix 8).

15) Do potential employers require a degree for graduates to gain employment in the field?

To become an expert in visual computing that can immediately contribute to the current challenges that industries are facing, a graduate degree that specifically trains students for visual computing is required. This is due to the fact that the topics and concepts of visual computing are highly technical and diverse, and these topics can only be communicated with students that already have a background in computer science or related fields. As a result, visual computing companies are mostly interested in hiring employees that are specifically trained in visual computing and hold a graduate degree. General software engineers are not qualified for visual computing markets as they don't have enough knowledge with adequate depth and breadth in visual computing areas such as deep learning, natural language processing, computer vision, and computer graphics. We have attached three job postings from respectable companies located in Canada that explicitly need the expertise that we provide to the students (See Appendix 9). Also, having a master's degree for these jobs is required.

16) Potential areas/sectors of employment for graduates and/or opportunities for further study in the field

All sectors related to computer vision, computer graphics, and machine learning can be targeted by our graduates. They can include game companies, companies dealing with visual tracking, autonomous driving, AR/VR, modern agriculture, autonomous driving, manufacturing software development, etc. In addition to visual computing specific jobs, students can be hired as software engineers and software developers as they have sufficient background knowledge in software engineering domains.

17) Does the proposal lead to a specific occupation?

Students can take jobs at various levels including but not limited to the following:

Computer vision engineer/expert: who is responsible for employing state-of-the-art computer vision concepts and skills to apply to a variety of problems such as identification, segmentation, classification in different industries such as image editing and manipulation, autonomous driving, remote quality controls in mining and agriculture, remote sensing, etc.

Computer graphics engineer: who is responsible for building graphics pipelines and employing relevant knowledge in 2D and 3D graphics to build software that can be used in a variety of industries such as animation, games, road design, simulation, etc.

Rendering Engineer: who is responsible for building rendering engines that can be used in different industries such as gaming, simulation, visual effects and so on. Considering the huge market of visual effects and games in Vancouver and giant companies like Electronic Arts, there is a large market for game developers and rendering engineers in Vancouver.

Deep learning engineer: who is capable of employing the recent and advanced techniques in deep learning and can apply them to many different application areas including natural language processing, robotics, data analysis, etc.

Software engineer: who can be hired in many different sectors including backend engineers, frontend engineer, full stack developers, etc. Considering the background of our students and the training that they will receive, they will be perfect candidates for general software engineering roles.

We have attached three job postings from respectable companies located in Canada that explicitly need the expertise that we provide to the students (See Appendix 9).

18) What labour market needs would the proposed program meet for the province? (Please include no more than 5 applicable National Occupational Classification (NOC) codes.)

Job market analysis

The visual computing market was valued at US$14.812 billion in 2017 and is projected to reach almost US$40 billion by 2025[6],[7]. Visual computing related industry in Canada is growing rapidly and requires experts that can fulfill this need. In Vancouver alone, over 60 studios make up the VFX and Animation industry, making it the world's largest cluster of domestic and foreign-owned studios[8]. There are many other areas and sectors that need the expertise of the students that will be trained in our program including robotics, autonomous driving, modern agriculture, game companies, etc. In addition to all the giant companies such as Apple, Google, Nvidia, Amazon, and Microsoft [9], medium-size companies are heavily investing in visual computing (e.g., computer vision, AI, deep learning). Therefore, there will be even more demand for visual computing experts for the foreseeable future.

Graduates from our program are classified as NOC: 2173 – software engineers and designers and also NOC: 2174 – Computer programmers and interactive media developers. Both categories are high-opportunity occupations in BC according to WorkBC statistics:

[6] https://www.marketsandmarkets.com/Market-Reports/visual-computing-market-157021061.html
[7] https://www.marketwatch.com/press-release/visual-computing-market-2021-top-countries-data-with-market-size-comprehensive-research-methodology-regional-study-and-business-operation-data-analysis-by-2025-2021-06-09
[8] https://www.vancouvereconomic.com/vfx-animation/
[9] https://www.forbes.com/sites/robtoews/2021/02/28/a-wave-of-billion-dollar-computer-vision-startups-is-coming/?sh=1e1adc043f4c

Table 1. B.C. Labour Market Outlook 2019 (this is the latest addition)

NOC	Employment 2019	Job Openings 2019-2020	Wage Rate Low	Wage Rate Medium	Wage Rate High
2174	2,620	1,020	$19.00	$47.69	$64.78
2173	11,060	4,480	$24.36	$38.46	$60.00

https://www.workbc.ca/Labour-Market-Industry/Labour-Market-Outlook.aspx

19) Plans for admissions and transfer within the British Columbia post-secondary education system

Students within the BC post-secondary education system will be admissible to the Program provided they meet the admission requirements. Transfer into the Program will be more challenging due to the Program's cohort nature and the two mandatory core lab courses, specializing on hands-on training across a range of fundamental visual computing skills. Transfer requests will thus have to be reviewed on a case-by-case basis in consultation with the Program Director and relevant faculty members. In all cases, students will need to apply for admission to the Program during the open admission period. Students who have previous graduate-level course credits not counted toward a prior credential and sufficiently similar to courses in the Program may receive specific transfer credit counting toward the Program.

Program graduates may be accepted for graduate or professional school programs at other institutions, but the visual computing master's degree is not intended as preparation for a doctoral degree or a research career. For most graduates, it will be the final degree leading to distinctively advanced professional opportunities.

There are no regulatory professional bodies relevant to the Program.

20) Enrolment Plan

The following projections focus on **full-time students only** as the program will not offer a part-time option during this time period.

For the first intake, we project to enroll about 35 students. Based on past trends in similar master's programs in the Faculty of Applied Sciences, we anticipate increased interest, but we plan on keeping the admission numbers steady at about 35 per intake since it matches our delivery capacity. We will strictly follow and comply with SFU's EDI policies and procedures.

21) Delivery methods

The Program will be delivered face-to-face. Students will complete at least 30 units of graduate work divided into three sections: 12 units of specialized hands-on lab courses, which comprise two courses with 6 units each; 12 units of required core courses; 3 units of electives; and 3 units for an industrial internship placement, typically working for at least four months with an industry partner in the visual computing sector anywhere in Canada. It will be delivered using a cohort model; this is required to manage the logistics around the highly specialized lab courses, which heavily rely on cutting-edge industrial-strength visual computing hardware-software environments. Further, it will streamline organizational efforts for placing student interns with industry partners, normally during summer terms, and for the fall terms for students who take an 8-month industrial internship.

22) Eligibility for scholarships, awards, and financial aid

Students are considered full-time and may apply for certain forms of external and internal support in the form of scholarships, awards, and financial aid as long as they meet all other eligibility criteria. Students will not be able to apply for scholarships and awards associated with internal funding.

23) Does the proposed program offer an alternative exit, if appropriate?

The proposed program does not offer an alternative exit to students who do not complete the program requirements. However, for a short-duration, course-based, industry-focused degree as this one, an alternative exit is not necessary, as individual courses carry considerable weight in industry. Students who successfully complete some, but not all courses can use the knowledge gained in those courses for professional advancement in the visual computing field in the same way that one might use stand-alone, domain-specific, technical certificates.

24) Resources required and/or available to implement the program

For this program, we have considered and allocated necessary personnel and equipment along with well-designed courses. The lab courses will focus on hands-on learning of various models, algorithms, and software. The labs themselves will be run by faculty members, professors of professional practice, and university research associates who are knowledgeable in the lab content. The students will receive considerable help from teaching assistants. The lab courses will be run in the Visual Computing Lab located in Blusson Hall at the SFU Burnaby campus. Since the lab courses provide the premium experience in this program, our plan is to continue to use this lab that

has recently acquired sophisticated, state-of-the-art computer hardware and software including GPUs that are essential for deep learning and visual computing projects. The lab is equipped with built-in projectors, several white boards, a shared area and other amenities that facilitate running lectures and fruitful discussions among students. Because of the extension plans of our programs, we are planning to add a third lab in order to avoid conflicts between programs. The new lab may be shared among the programs (see budget allocation).

The lab is spacious enough to accommodate 36 students. Labs will be run by TAs and instructors following meticulously planned hands-on practices, exercises, and mini assignments. To fulfill the needs of advanced visual computing assignments and prepare high-quality and state-of-the-art teaching material, the lab is equipped with a set of hardware and software. For the labs' software and hardware requirements, we intend to use the following resources:

• Premium workstations and displays available in the Visual Computing lab.

• Educational Unity and Blender are installed on all the machines. These are software programs and development tools that are vastly used by industries such as gaming or animation.

• Deep learning libraries such as Tensorflow, Keras, and PyTorch are provided.

• Other necessary coding environments and libraries necessary for visual computing (e.g., Matlab, OpenCV, OpenGL, etc.) are provided.

For the program, we will need 1 University Research Associate (URA) and 1 continuing faculty member to take charge of and teach each of the two lab courses and lecture courses, and also support developing employment opportunities for the students, and preparing them for their co-op / industrial internship placements (e.g., coaching them for technical interviews).

The faculty members are needed to teach the lab courses. These are innovative lab courses, and the course development necessitates the creation of a series of programming assignments that will impart hands-on experiences in programming with the tools commonly used in their area of visual computing. Each of the 6-unit lab courses will require 12 hours per week for students (using the typical 0.5 unit per weekly lab hour). A faculty member will be assigned to each 6-unit lab course, where each section will have a maximum capacity of 36 students. There will also be substantial teaching assistant support in the labs to assist students with their assignments.

Our new visual computing program together with the Professional Computer Science program would be supported by 1 Program Director, 1 Program Coordinator, 1 Program Assistant and 1 Research Assistant (part-time). 1 additional Program Coordinator will be needed in the future. Cost for administration will be shared equally between all programs.

To support the mandatory co-op or industrial internship component of the program, the School of Computing Science will be working with the FAS graduate co-op office. The co-op administration of 3 master programs will be supported by 1 Co-op Coordinator, 1 Co-op Career Advisor, and 1 Co-op Program Assistant. The cost for this will be shared by all 3 programs but since the staffing

depends on the number of students enrolled in the program the cost is not shared equally. According to student numbers 60% of the co-op administration will be carried by the Professional Computing Program and 20% by each Professional Cybersecurity and Visual Computing. These co-op staff members will help the students prepare their applications, assist with the interview process, monitor the placements, deal with program marketing and opportunity development (in order to successfully place all students, the identification of over 100 possible positions is required).

25) Program evaluation and academic/administrative oversight

Academic and administrative oversight will be provided by the steering committee for the program. Currently, the steering committee consists of the program director (Dr. Jiannan Wang, Associate Professor), the computing science graduate program director (Dr. Jiangchuan Liu), the director of the School of Computing Science (Dr. Mohamed Hefeeda), three visual computing professors in the program (Dr. Richard Zhang, Dr. Angel Chang and Dr. Kangkang Yin) and one assistant professor of professional practice in the program (Dr. Ali Mahdavi Amiri).

The program will be reviewed internally using the same mechanisms that are used to review the other graduate programs in the School of Computing Science. Program changes will be administered through the existing School of Computing Science Graduate Program Committee.

The school has already established an external advisory committee for the program, and this advisory committee will be expanded. The external advisory committee currently has four members, who are industrial technical leaders in visual computing. Advisory members each serve a 3-year term. Each member can serve at most two terms on the advisory board.

Advisory members meet two times per year (usually early December & early April) to discuss strategic priorities for the program. The advisory council provides input regarding industry expectations, related professions and societal trends. Advisory members' feedback and guidance allow the program to be responsive to changes in its external environment due to technological advances, industry needs, government priorities, and community and professional expectations.

In addition, co-op employers and students will be given surveys on a regular basis with respect to the program content and structure to receive input in order to make the program better and more up to date.

26) Faculty member's teaching/supervision

The teaching and supervision needs of the program will be provided by the faculty members in the table below which also shows their research expertise, complemented by one Assistant Professor in Professional Practice (shown in italics below) who will play the main role in the program in terms of industry relations, teaching, and supervision. The program will not affect regular faculty members' involvement in other programs.

Course	Name	Research Area	Percentage
CMPT 757: Machine Learning	Mo Chen	Robotics and Autonomous Systems	13%
	Greg Mori	Computer Vision, Machine Learning	13%
	Oliver Schulte	Machine Learning, Computational Logic, Computational Decision Theory	13%
CMPT 813: Computational Geometry	Binay Bhattacharya	Computational Geometry, Pattern Recognition	13%
CMPT 764: Geometric Modelling in Computer Graphics	Hao (Richard) Zhang	Computer Graphics, Geometric Modelling	13%
CMPT 767: Visualization	Steven Bergner	Big Data	13%
CMPT 820: Multimedia Systems	Mohamed Hefeeda	Computer Networks, Multimedia Communications	13%
CMPT 822: Computational Vision	Yasutaka Furukawa	Computer Vision, Deep Learning, Computer Graphics & Computational Photography	13%
CMPT 742/743: Practices in Visual Computing	*Ali Mahdavi Amiri*	*Computer Graphics, Deep Learning, Geometric Modelling*	*70%*
	Manolis Savva	Computer Vision, Computer Graphics, Robotics	13%
CMPT 880: Deep Learning	Oliver Schulte	Machine Learning, Computational Logic, Computational Decision Theory	13%
CMPT 825: Natural Language Processing	Angel Chang	Computer Vision, Computer Graphics, Natural Language Processing	13%

CMPT 766: Computer Animation and Simulation	Kangkang Yin	Computer Graphics, Computer Animation	13%

27) Is the program focus primarily on meeting social benefit(s) or economic benefit(s)?

Economic benefits might be met more by our program as the visual computing industry is rapidly expanding. However, visual computing can be beneficial in other aspects including social benefits and goods. For instance, visual computing can provide cheaper and more accessible medical services by automating cancer diagnosis and bone fracture or heart disease identifications. It can also be used for automatic fall detection for seniors and monitor their health condition. Recently, visual computing has been vastly used in the automotive industry to design autonomous cars that can ultimately provide safer, more accessible and cheaper transportation to society. In addition, visual computing is heavily used in agriculture and farming for yield estimation, plant disease identification, automatic disease detection and monitoring of calves, and automated farming. Our program will focus on these applications and train experts that can be acquired by such industries.

We make sure that students will receive proper training in terms of ethics. We will make clear that their professional activities and their final outcomes and conclusions must be well-justified, requiring honesty, objectivity, transparency and ethical professional practices. In addition, their activities consider the welfare of all those involved and affected, whether directly or indirectly, and minimize the negative impact of their work on greater society, and the environment. They will also learn that if their work has research components, research participants must be treated with respect and resources should be used efficiently and thoughtfully.

28) How would the proposed program advance social goods or government priorities?

Visual data is ubiquitous and therefore any section that works with imagery, video, spatial data (e.g., Lidar), etc. can benefit from our program as it trains individuals with skills to manipulate and analyze such datasets. Various priorities of the government can benefit from our program as they are dealing with visual data. For instance, visual computing experts can help strengthen border security as they can design algorithms to detect guns or other prohibited goods in travelers' luggage.

29) What social, cultural, regional, community, environmental, institutional and/or intellectual benefit would the proposed program provide?

Our proposed program will train individuals with particular skills that can be used to contribute to many different aspects of society including industries dealing with environmental challenges. Our trained students can analyze satellite images and identify lands that are endangered by fire, drought,

or flood to protect the environment. In addition, since our program is a multi-cultural program, it also contributes to society's diversity.

30) How would the proposed program support economic growth and/or government economic priorities?

One of the main focuses of our visual computing program will be on machine learning, artificial intelligence (AI), and deep learning. Therefore, it is also highly aligned with the Pan-Canadian AI strategy of the government that aims to produce trainees and researchers in the field of AI: https://www.tradecommissioner.gc.ca/innovators-innovateurs/strategies.aspx?lang=eng.

The program is also aligned with Canada's superclusters which aim to promote innovation and cutting-edge technologies since visual computing is a very popular and in-demand area for both research and technology. In addition, students in this program are trained so that they would be able to make useful products. As a result, these trained individuals can potentially be entrepreneurs that can create jobs and boost the Canadian economy.

31) What direct and/or indirect economic, industrial or labour market benefits would the program offer the student, community, region or province?

Students will benefit from their co-op / industrial internship placements, and they will learn useful skills that can be applied when working with local companies after graduation. With the state-of-the-art skills that students gain in areas of visual computing including computer vision, machine learning, deep learning, etc., they are ready to contribute to a variety of industries in BC and Canada including game design, agriculture, medical, and so on. Considering the huge market of visual computing in Canada and especially Vancouver such as visual effects, gaming, and agriculture, students that graduate from this proposed program will directly contribute to local companies and help boost the economy. Terramera, for example, is a local company using visual computing techniques to improve agricultural tasks such as disease detection and yield estimation. MetaOptima uses visual computing approaches to identify skin anomalies such as melanoma. Electronic Arts is one of the main game producers around the world that employs all kinds of different visual computing experts to build and develop video games. There are many other companies in different sectors that need visual computing expertise such as OneCup AI, Motion Metrics, and Softree, to name a few.

APPENDICES

Appendix 1 Calendar entry

School of Computing Science | Professional Visual Computing

Master of Science

Description of Program

The Master of Science in Professional Visual Computing engages students in developing deep knowledge and practical skills in the area of visual computing. The program trains visual data scientists and engineers who apply specialized knowledge in computer science to develop cutting-edge tools, stimulate product innovation, and explore new technology fronts in all commercial, engineering, and creative professions. Students take instructional and applied courses in a cohort, and complete work placement through SFU's co-op program, allowing them to tackle real-world scientific, engineering, and socio-economic problems and gain valuable project management experience while expanding their network of industry contacts. This full-time master's program is suitable for students with a strong aptitude in computer science, or other quantitative fields, such as engineering and mathematics.

Admission Requirements

Applicants must satisfy the University admission requirements as stated in Graduate General Regulation 1.3 in the SFU Calendar. Applicants should normally have a bachelor's degree, or equivalent in computer science or a related field. Students who do not meet the minimum university requirements may be recommended as conditional or qualifying students as per Graduate General Regulation (GGR) 1.3.8 or 1.3.9.

For further information on conditional or qualifying admission requirements, please contact the Program Coordinator.

Program Requirements

This program consists of course work, and co-op or graduate project for a minimum of 30 graduate units. Students must maintain a minimum 3.0 CGPA throughout their graduate career.

Students complete all of:

CMPT 726 - Machine Learning (3)
CMPT 742 - Practices in Visual Computing I (6)
CMPT 743 - Practices in Visual Computing II (6)
CMPT 756 – Distributed and Cloud Systems (3)

and an additional nine units of graduate courses in Computing Science

and one of

CMPT 626 - Graduate Co-op I (3)

or

CMPT 629 - Graduate Project (3)

Program Length

Students are expected to complete the program requirements in four terms.

Other Information

Co-op

A co-op is an integral part of this program. However, it is offered on a competitive basis.

All students are required to apply for a co-op. With assistance from the co-op coordinator for this program, students will be expected to find a suitable industry partner. Students may complete one or two terms of co-op. The latter option is in place to satisfy requests from our industrial partners for continuity and to carry out a large-scale project. Students are required to enroll in at least one of the program courses in the term following their co-op.

In the event that a student is unable to secure a co-op during the summer term, they will be required to go on academic break since no courses will be offered. The student will be able to apply for a co-op in the subsequent term or, if unsuccessful, will be required to undertake additional course work. In consultation with the program director, the student may complete a graduate project in their final term to fulfill program requirements.

Academic Requirements within the Graduate General Regulations

All graduate students must satisfy the academic requirements that are specified in the graduate general regulations, as well as the specific requirements for the program in which they are enrolled.

Appendix 2 Letters of support

Following are copies of nine letters of support from the following organizations:

- SFU, Faculty of Communication, Art and Technology
- Centre for Digital Media
- University of British Columbia
- DaoAI
- Electronic Arts (EA)
- Softree Technical Systems
- Terramera

SFU SIMON FRASER UNIVERSITY

FACULTY OF COMMUNICATION, ART, AND TECHNOLOGY
OFFICE OF THE DEAN

8888 University Dr.
Burnaby, BC, V5A 1S6

TEL + 1 778-782-2168
SFU.CA/FCAT

October 28, 2021

Dr. Jiannan Wang
Program Director, Professional Computer Science Master of Science Program
School of Computing Science
Simon Fraser University
8888 University Drive
Burnaby BC, V5A 1S6

Re: Letter of Support, Master of Professional Visual Computing

Dear Dr. Wang,

I am writing to provide strong support for the creation of the Master of Professional Visual Computing Program at Simon Fraser University (SFU).

As you know, I am Dean of the Faculty of Communication, Art, and Technology and Professor in the School of Interactive Arts and Technology (SIAT) at SFU. As an interdisciplinary program spanning media arts, design, and interactive computing systems, SIAT includes many complementary areas of research and teaching to SFU's School of Computing Science and continues to be a strong supporter of visual computing within your school. My research and teaching are in the areas of human-computer interaction and interaction design and so I have a strong personal interest and background in visual computing. I am also quite familiar with the Visual Computing specialization in your Professional Master of Science program since I recently served on the External Review committee for the School of Computing Science last year.

I strongly support the creation of Master of Professional Visual Computing Program as I feel that Visual Computing has been and will continue to be an area of educational training that is in high demand by both students and industry.

To my knowledge, visual computing is the area where the School of Computing Science has hired the largest number of new faculty members in the past five years, including the highly esteemed and past NSERC E.W.R. Steacie Memorial Fellow, Dr. Sheelagh Carpendale. Given the strong faculty member count and their diverse skill sets in a range of visual computing areas, I believe that the School of Computing Science is exceptionally well positioned to deliver the Master of Professional Visual Computing Program.

Overall, I feel that the Master of Professional Visual Computing Program at SFU will help position British Columbia as a leader in visual computing within Canada and North America. The program will provide graduates that will help grow B.C.'s technology sector, especially in the area of digital media, as well as enhance other sectors that are increasingly dependent on visual data, such as health, design and manufacturing, as well as energy and resources.

I look forward to a very bright future for the Master of Professional Visual Computing Program.

Sincerely,

Dr. Carman Neustaedter
Dean, Faculty of Communication, Art, and Technology
Professor, School of Interactive Arts and Technology, SFU

2

CDM

July 18, 2020

Dr. Jiannan Wang
Program Director, Professional Computer Science Master of Science Program
School of Computing Science
Simon Fraser University
8888 University Drive
Burnaby BC, V5A 1S6

Re: Letter of Support, Professional Master's Program in Visual Computing

I am writing to provide support for the creation of the **Professional Master of Science in Visual Computing** degree program at SFU. To my understanding, the School of Computing Science has been offering the Visual Computing specialization of the Professional Computer Science Master of Science Program since 2018. The current effort is to convert that program into a permanent offering for students and with a Professional Master of Science designation.

I have been a Professor of Professional Practice at the Centre for Digital Media (CDM) since 2015 and am also a digital media consultant. The CDM is the home of the Master of Digital Media Program (MDM) which confers a graduate degree from four partner institutions: SFU, UBC, ECU, and BCIT. I was also the Studio Head of MGN Studios from 2018-2020, Studio Head and VP Technology of Radical Entertainment from 2007-2014, Senior Director within Activision's Central Studios from 2012-2014, and VP Technology of Mainframe / Rainmaker Entertainment from 1997-2007. Prior to that, I was an Associate Professor in the School of Computing Science and co-director of the Graphics and Multimedia Research Lab at Simon Fraser University from 1992-1999. I have authored over 50 journal and conference papers in the areas of computer graphics and scientific visualization, and have over 35 credits in video games, direct-to-video movies, and television series. I have also had the pleasure of serving on multiple media industry advisory boards for institutions such as the Great Northern Way, FCAT/SFU, VFS, MITACS, HP, Autodesk, the Entertainment Software Association of Canada, and the Canadian Video Game Awards. I am also a member of IGDA and ACM SIGGRAPH (Pioneer).

The initial offering of the Visual Computing specialization at the SFU School of Computing Science has already established itself as providing knowledge and training needed by B.C. industries. Studies in Canada and the U.S. both call for the critical need for graduates with strong technical skills in computer vision, computer graphics, and visualization. The value chain related to visual computing spans from obtaining and handling large amounts of visual data through to the extraction of knowledge from the data to taking action on extracted knowledge to effect change in organizations.

Demand is growing for visual computing expertise within all sectors, and across a variety of business domains. The technical focus of SFU's Visual Computing program combined with the co-op opportunities makes it unique and very relevant for Canada and globally. It differs significantly from the Master of Digital Media program at the CDM. While both are professional programs without a research component and share the same goal of preparing students for industry, the MDM program is multidisciplinary, with students whose undergraduate backgrounds include art, design, management, and software development, and is focused on developing essential communication, collaboration & leadership skills with an emphasis on experiential learning through project courses.

UBC SFU BCIT

CENTRE FOR DIGITAL MEDIA | 685 GREAT NORTHERN WAY | VANCOUVER, BC CANADA | V5T 0C6 | theCDM.ca

CDM

In summary, I strongly support the creation of the Professional Master of Science in Visual Computing degree program at SFU. In British Columbia alone, there are over 900 companies specializing in digital media and visual computing. This program would significantly contribute to the demand for highly qualified talent.

Yours sincerely,

F. David Fracchia
Professor of Professional Practice
Simon Fraser University, FCAT
Master of Digital Media Program
@ the Centre for Digital Media
685 Great Northern Way, Vancouver BC V5T 0C6

CENTRE FOR DIGITAL MEDIA | 685 GREAT NORTHERN WAY | VANCOUVER, BC CANADA | V5T 0C6 | theCDM.ca

UBC SFU BCIT

UNIVERSITY OF BRITISH COLUMBIA

Michiel van de Panne
Professor
Department of Computer Science
201 – 2366 Main Mall
Vancouver BC Canada V6T 1Z4

Telephone: (604) 822-8737
Facsimile: (604) 822-4231
E-mail: van@cs.ubc.ca

October 13, 2021

Dr. Jiannan Wang
Program Director, Master of Science in Professional Computing Science
School of Computing Science
Simon Fraser University
8888 University Drive
Burnaby BC, V5A 1S6

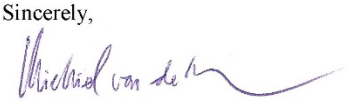
Re: Letter of Support, Professional Visual Computing Program

I am writing to support the creation of the Professional Visual Computing Program at Simon Fraser University (SFU). My own research interests and expertise lie squarely in visual computing, more specifically in the area of Computer Animation. I include a brief biography at the end of this letter. More broadly, I track research in many areas of visual computing and the many rapid advances that are happening.

In recent years, there has been immense growth in the accumulation and flow of visual data (e.g., images, videos, and 3D content), which is characterized by high volume and variety, with many emerging opportunities to transform the visual data into business intelligence, as well as to synthesize new visual data for applications that include visual effects, simulations in support of training and machine learning, and games. The program is well designed and is well-placed to meet the requirements of the marketplace. A focus on technical training through advanced graduate-level courses will teach students core technical skills including the required mathematical methods, machine learning, software development, data analytics, and the necessary domain knowledge in visual computing to give them a competitive advantage. Hands-on and project-oriented courses, together with coop experiences, will prepare the students to enter a variety of in-demand jobs immediately upon graduation. The hands-on courses are designed to engage industry partners from diverse domains to access extensive visual data as well as opportunities for the students to work on industry problems.

The School of Computing at SFU is well positioned to deliver this program as the members possess the diverse skill sets needed for this emerging discipline. The School boasts one of the largest and strongest research cluster in computer graphics, vision, visualization, and robotics in Canada.

Sincerely,



Michiel van de Panne

Michiel van de Panne is a Professor in the Department of Computer Science at the University of British Columia, with research interests that span computer graphics, computer animation, and robotics, with a strong focus on modeling human and animal motion and the motor skills that underly their movement, and application of machine learning methods to modeling motion and other phenomena. He completed 10 years as a Tier 2 Canada Research Chair in Computer Graphics and Animation at UBC. He co-founded the ACM/Eurographics Symposium on Computer Animation (SCA), and regularly serves on program committees that include ACM SIGGRAPH and SCA, and has co-chaired multiple conferences. He was awarded the 2016 CHCCS Achievement Award for Canadian researchers who have made substantial contributions to computer graphics, visualization, or HCI. His research has been recognized with grants from NSERC DAS, NSERC, GRAND, Adobe, and MITACS and has been used in games, visual effects for film, games, and robotics, as well as being featured in the MIT Technology Review, Engadget, and elsewhere. His former students and postdocs have won 5 best paper awards since 2013; have gone on to cofound companies that include Element AI, Anomotion, and VGC; have assumed key leadership related to AI, including at Tesla (Director of AI) and DeepMotion (Chief Scientist). Others hold faculty positions at universities including ETH Zurich, SFU, Leeds, and York.

Dr. Jiannan Wang
Program Director, Master of Science in Professional Computing Science
School of Computing Science
Simon Fraser University
8888 University Drive
Burnaby BC, V5A 1S6

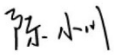
Re: Letter of Support, Professional Visual Computing Program

Please accept this letter for the creation of the SFU's of Professional Visual Computing Program.

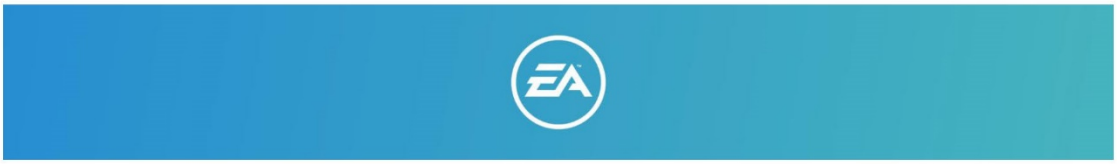
My name is Xiaochuan Chen, CTO of DaoAI Robotics, I'm also alumni of SFU Master of Computer Science with research area in computer vision. In the process of finding qualified candidates for 3D computer vision engineers, we found there is a huge gap in today's job market, and I feel there is an urgent need for such a program. We have had positive experiences with SFU in the past and we are certain that this program will be successful.

Regards,

Xiaochuan Chen



Signature



October 14, 2021

Dr. Jiannan Wang
Program Director, Master of Science in Professional Computing Science
School of Computing Science
Simon Fraser University
8888 University Drive
Burnaby, BC V5A 1S6

Re: Letter of Support Professional Visual Computing Program

Please accept this letter of support for the creation of SFU's Professional Visual Computing Program.

The field of visual computing has found many applications in recent years, specifically in the gaming industry. Examples of these applications are in processing the game state from game pixels to automate game play testing, finding defects and automating screen navigation. There is a scarcity of qualified individuals in this area of study, and it can take several months to recruit talent.

I highly recommend the creation of SFU's Professional Visual Computing Program as this field is of high importance and can solve many industry level problems.

Sincerely,

Kevin Loken, M.Sc., P.Eng
Head of Technology, EA Create
Electronic Arts

Dr. Jiannan Wang
Program Director, Master of Science in Professional Computing Science
School of Computing Science
Simon Fraser University
8888 University Drive
Burnaby BC, V5A 1S6

October 15, 2021

Re: Letter of Support, Professional Visual Computing Program

Please accept this letter for the creation of SFU's Professional Visual Computing Program.

Softree is a company located in BC, Canada that develops civil engineering software built for the development of rural and resource infrastructure. Today our clients include consultants, governments, landowners, and other stakeholders in a variety of industries all over the world.

Building such software requires demanding knowledge in different areas of visual computing including, mesh processing, image processing and computer graphics. Unfortunately, there is not enough applicant on the job market with such skills. As a result, we believe that creation of SFU's Professional Visual Computing Program will be very beneficial to the local companies and we highly recommend this program.

Kind regards,

Erin Wasney

Oct, 2021

Dr. Jiannan Wang
Program Director, Master of Science in Professional Computing Science
School of Computing Science
Simon Fraser University
8888 University Drive
Burnaby BC, V5A 1S6

Re: Letter of Support, Professional Visual Computing Program

Dear Dr. Wang,

As an employer of coop students from SFU in the past, we want to express our strong support for the program.

As you may know, it is extremely hard to find and recruit talent in the area of machine vision since the state-of-the-art of often falls outside the boundaries of otherwise excellent programs such as SFU's Big Data program. The SFU Professional Visual Computing program's focus on building student understanding of machine vision fundamentals, neural architectures, and classical computer vision techniques offers much to both students and companies here in BC. We've been disappointed by the quality of similar professional masters' programs from other universities, but considering high caliber faculty members of SFU in the area of Visual Computing, we are certain that SFU can fill this gap.

We hope that you institutionalize this program as it will be of great benefit to all for many years to come. SFU is a great partner to us in our shared Supercluster program, and we consider your Professional Visual Computing Program to be a gem.

Travis Godwin Good, Ph.D.
Chief Technology Officer | *Terramera Inc.*
Direct: (604) 262 1933
Cell: (402) 704 9655
Email: travis.good@terramera.com

Visit us online at www.terramera.com

Terramera, Inc. 333 Seymour St, Ste 1100, Vancouver, BC, Canada V6G 5A6
tel: (604) 639-9600 fax: (604) 909-1833

Appendix 3 Memo from the library

SFU SIMON FRASER UNIVERSITY

MEMO

SFU Library

8888 University Drive
Burnaby, BC V5A 1S6
Canada

ATTENTION CHRISTINA MARGRAF

FROM Patty Gallilee

RE Visual Computing Master of Science in Professional Computer Science

DATE October 27, 2021

Dear Christina,

The library fully supports the creation of a new program, the **Professional Visual Computing Program**

We have been supporting students in Computing Science's Professional Master Program since 2018, including the courses which are included in the program. We anticipate being able to continue this level of support as the program develops.

The primary support person in the Library for this program is Holly Hendrigan, Liaison Librarian for Computing Sciences. Holly provides research and teaching support, and expertly stewards our ever-adapting collection of Computing Science resources.

Graduate students are also well supported by the SFU Library Research Commons, and other Library resources and services such as Research Data Management.

The SFU Library welcomes the creation of this program, and looks forward to continuing our partnership with the program.

Best,
Patty Gallilee
Associate Dean of Libraries, Collections and Scholarly Communication

Patty Gallilee

SIMON FRASER UNIVERSITY ENGAGING THE WORLD

Appendix 4 Details of program steering committee (if applicable)

Jiannan Wang (Director, Professional Computer Science Program)

Jiangchuan Liu (Director, Graduate Program in Computing Science)

Mohamed Hefeeda (Director, School of Computing Science)

Richard Zhang (Associate Director, Research and Industry Relations)

Ali Mahdavi Amiri (Assistant Professor of Professional Practice, School of Computing Science)

KangKang Yin (Associate Professor, School of Computing Science)

Angel Chang (Associate Professor, School of Computing Science)

We consider adding another faculty member from the School of Criminology.

Appendix 5 Abbreviated curriculum vitae for faculty

ANGEL XUAN CHANG
angelx@sfu.ca,
http://angelxuanchang.github.io/

CURRENT AFFILIATIONS

Simon Fraser University — Vancouver, BC Canada
School of Computing Science
Assistant Professor — August 2019 to present
Canada CIFAR AI Chair at Amii

EDUCATION

Stanford University — Stanford, CA
Ph.D. in Computer Science — December 2015
Thesis: Text to 3D scene generation
Advisor: Christopher D. Manning

Massachusetts Institute of Technology — Cambridge, MA
Master of Engineering in EECS — February 2000
Bachelor of Science in Computer Science — June 1999

RESEARCH INTERESTS

My research lies at the intersection of natural language understanding, computer graphics, and AI. My research focuses on the connection of language to 3D representations of shapes and scenes and addresses grounding of language for embodied agents in indoor environments. I'm interested in how can we build intelligent agents that we can communicate with using natural language and that can navigate in and interact with objects in 3D environments (e.g. a robot that can ``put away the dishes''). I also worked on methods for synthesizing 3D scenes and shapes, 3D scene understanding, and the creation of large-scale 3D datasets, simulation frameworks and interactive assets for training embodied AI agents.

SELECTED PUBLICATIONS

S. Patel, S. Wani, U. Jain, A. Schwing, S. Lazebnik, M. Savva, A. X.Chang. "Emergent Communication in Collaborative Multi-Object Navigation." In *Proceedings of ICCV 2021*.

K. Wang, X. Xu, L. Lei, S. Ling, N. Lindsay, A. X. Chang, M. Savva, D. Ritchie. "Roominoes: Learning Assemble 3D Rooms into Floor Plans." In *Proceedings of SGP 2021*.

D. Z. Chen, A. Gholami, M. Nießner, A. X. Chang. "Scan2Cap: Context-aware Dense Captioning in RGB- D Scans." In *Proceedings of CVPR 2021*.

M. Vidanapathirana, Q. Wu, Y. Furukawa, A. X. Chang, M. Savva. "Plan2Scene: Converting Floorplans to 3D Scenes." In *Proceedings of CVPR 2021*.

J. Tan, W. Lin, A. X. Chang, M. Savva. "Mirror3D: Depth Refinement for Mirror Surfaces." In *Proceedings of CVPR 2021*.

X. Xu, D. Charatan, S. Raychaudhuri, H. Jiang, M. Heitmann, V. Kim, S. Chaudhuri, M. Savva, A. X. Chang,
D. Ritchie. "Motion Annotation Programs: A Scalable Approach to Annotating Kinematic Articulations in Large 3D Shape Collections." In *Proceedings of 3DV 2020*.

S. Wani, S. Patel, U. Jain, A. X. Chang, M. Savva. "Multi-ON: Benchmarking SemanticMap Memory using Multi-Object Navigation." In *Proceedings of NeurIPS 2020.*

V. Setlur, E. Hoque, D. H. Kim, A. X. Chang. "Sneak Pique: Exploring Autocompletion as a Data Discovery Scaffold for Supporting Visual Analysis." In *Proceedings of UIST 2020*.

D. Z. Chen, A. X. Chang, M. Nießner. "ScanRefer: 3D Object Localization in RGB-D Scans using Natural Language," In *Proceedings of ECCV 2020.*

F. Xiang, Y. Qin, K. Mo, Y. Xia, H. Zhu, F. Liu, M. Liu, H. Jiang, Y. Yuan, H. Wang, L. Yi, A. X. Chang, L. Guibas, H. Su. "SAPIEN: a SimulAted Part-basedInteractive Environment," In *Proceedings of CVPR 2020.*

K. Wang, Y-A Lin, B. Weissmann, M. Savva, A. X. Chang, D. Ritchie. "PlanIT: Planning and Instantiating Indoor Scenes with Relation Graph and Spatial Prior Networks," In *Proceedings of SIGGRAPH 2019*.

K. Mo, S. Zhu, A. X. Chang, L. Yi, S. Tripathi, L. J. Guibas, H. Su. "PartNet: A Large-scale Benchmark for Fine-grained and Hierarchical Part-level 3D Object Understanding," In *Proceedings of CVPR 2019.*

A. Avetisyan, M. Dahnert, A. Dai, M. Savva, A. X. Chang, M. Nießner. "Scan2CAD: Learning CAD Model Alignment in RGB-D Scans," In *Proceedings of CVPR 2019*.

Y. Shi, A. X. Chang, Z. Wu, M. Savva, K. Xu. "Hierarchy Denoising Recursive Autoencoders for 3D Scene Layout Prediction," In *Proceedings of CVPR 2019.*

K. Chen, C. B. Choy, M. Savva, A. X. Chang, T. Funkhouser, S. Savarese. "Text2Shape: Generating Shapes from Natural Language by Learning Joint Embeddings." In *Proceedings of ACCV 201*8.

K. Wang, M. Savva, A. X. Chang, D. Ritchie. "Deep Convolutional Priors for Indoor Scene Synthesis," In *Proceedings of SIGGRAPH 2018.*

S. Song, A. Zeng, A. X. Chang, M. Savva, S. Savarese, T. Funkhouser. "Im2Pano3D: Extrapolating 360 Structure and Semantics Beyond the Field of View," In *Proceedings of CVPR 2018*.

A. X. Chang, A. Dai, T. Funkhouser, M. Halber, M. Nießner, M. Savva, S. Song, A. Zeng, Y. Zhang. "Matterport3D: Learning from RGB-D Data in Indoor Environments," In *Proceedings of 3DV 2017*.

L. Shao, A. X. Chang, H. Su, M. Savva, L. Guibas. "Cross-modal Attribute Transfer for Rescaling 3D Models," In *Proceedings of 3DV 2017*.

A. Dai, A. X. Chang, M. Savva, M.f Halber, T. Funkhouser, M. Nießner. "ScanNet: Richly-annotated 3D Reconstructions of Indoor Scenes," In *Proceedings of CVPR 2017*. Received SGP dataset award 2020.

S. Song, F. Yu, A. Zeng, A. X. Chang, M. Savva, T. Funkhouser. "Semantic Scene Completion from a Single Depth Image," In *Proceedings of CVPR 2017*.

V. Setlur, S. E. Battersby, M. Tory, R. Gossweiler, A. X. Chang. "Eviza: A Natural Language Interface for Visual Analysis," In *Proceedings of UIST 2016*.

M. Savva, A. X. Chang, P. Hanrahan, M. Fisher, M. Nießner. "PiGraphs: Learning Interaction Snapshots from Observations," In *Proceedings of SIGGRAPH 2016.*

A. X. Chang, W. Monroe, M. Savva, C. Potts, C. D. Manning. "Text to 3D Scene Generation with Rich Lexical Grounding", In *Proceedings of ACL 2015*.

M. Savva, A. X. Chang, P. Hanrahan, M. Fisher, M. Nießner. "SceneGrok: Inferring Action Maps in 3D Environments", In *Proceedings of SIGGRAPH Asia 2014*.

A. X. Chang, M. Savva, C. D. Manning. "Learning Spatial Knowledge for Text to 3D Scene Generation", In

Proceedings EMNLP 2014.

PREPRINTS/ WORKSHOP PAPERS

A. Szot, A. Clegg, E. Undersander, E. Wijmans, Y. Zhao, J. Turner, N. Maestre, M. Mukadam, D. Chaplot, O. Maksymets, A. Gokaslan, V. Vondrus, S. Dharur, F. Meier, W. Galuba, A. X. Chang, Z. Kira, V.Koltun, J. Malik, M. Savva, D. Batra. "Habitat 2.0: Training Home Assistants to Rearrange their Habitat," *arXiv preprint arXiv:2106.14405 [cs.LG,cs.RO]*, 2021

D. Batra, A. X. Chang, S. Chernova, A. J. Davison, J. Deng, V. Koltun, S. Levine, J. Malik, I. Mordatch, R. Mottaghi, M. Savva, H. Su. "Rearrangement: A Challenge for Embodied AI," *arXiv preprint arXiv:2011.01975 [cs.AI RO]*, 2020

P. Anderson, A. X. Chang, D. S. Chaplot, A. Dosovitskiy, S. Gupta, V. Koltun, J. Kosecka, J. Malik, R. Mottaghi, M. Savva, A. R. Zamir. "On Evaluation of Embodied Navigation Agents," *arXiv preprint arXiv:1807.06757 [cs.AI], 2018*

M. Savva, A. X. Chang, A. Dosovitskiy, T. Funkhouser, V. Koltun. "MINOS: Multimodal Indoor Simulator for Navigation in Complex Environments," *arXiv preprint arXiv:1712.03931 [cs.LG], 2017*

A. X. Chang, T. Funkhouser, L. Guibas, P. Hanrahan, Q. Huang, Z. Li, S. Savarese, M. Savva, S. Song, H. Su, J. Xiao, Li.Yi, F.Yu. "ShapeNet: An Information-Rich 3D Model Repository," *arXiv preprint arXiv:1512.03012 (2015)*. Received SGP dataset award 2018.

SUPERVISED STUDENTS

Simon Fraser University

Graduate Student Supervision (Senior Supervision)

Ph.D: Yasaman Etesam, Sonia Raychaudhuri, Han-Hung Lee
M.Sc: Hanxiao (Shawn) Jiang, Yue Ruan, Leon Kochiev, Ali Gholami, Akshit Sharma

Undergraduate Student Supervision: Hanxiao (Shawn) Jiang (next M.Sc. SFU), Qirui Wu, Weijie Lin

Co-Supervision at Technical University of Munich part of **TUM-IAS Hans Fischer** fellowship

Ph.D: Dave Zhenyu Chen with Matthias Nießner as main supervisor

GRANTS CFI-JELF (2020-2025), NSERC-Discovery (2020-2025) with launch supplement, CIFAR AI Chair (2019- 2024), SFU-PRG (2019-2024), Facebook AI Research Grant for capturing interactive 3D Environments (2020-2021), Hans Fischer Fellowship (2018-2022).

Binay Bhattacharya
Professor / Computing Science

Educational Background

1982	Ph.D.	Computer Science, McGill University, Canada "Application of computational geometry to pattern recognition problems"
1978	M.Sc.	Computer Science, McGill University, Canada "Some numerical computations in linear estimation"
1969	M.Sc.	Pure Mathematics, University of Calcutta, India

Senior Supervisory Duties of a Thesis/Dissertation/or Major Project

Name	Degree	Project/Thesis Title	Status	Began	Completed
Senior Supervisor					
Alan Mao	M.Sc.	Spatial skyline points in metric spaces.	Active	2018-3	
Yu Tang	M.Sc.	Shortest paths in discretized time window	Active	2018-3	
Mozafari Khameneh, Amirhossein	Ph.D.	Facility location in dynamic flow networks	Active	2016-3	
Asghari, Hossein	M.Sc.	Accurate and Rapid Detection of Circular RNA through Splice-Aware Pseudo-Alignment Scheme I became Hossein's Senior Supervisor after the departure of Dr. Cenk Sahinalp. Dr. Hatch effectively guided Hossein.	Completed	2017-2	2020-3

Name	Degree	Project/Thesis Title	Status	Began	Completed
Hamid Homapour	M.Sc.	Pattern matching of point sets	Completed	2017-3	2019-3
Sokol, Vladyslav	Ph.D.	On Few Nonlinear Assignment Problems	Completed	2013-2	2018-3
Vijayvargiya, Vishal	M.Sc.	Model for Police Dispatching and Shift Scheduling	Completed	2015-3	2017-3
Acharyya, Rashmisnata	M.Sc.	2-median in tree networks	Completed	2016-1	2017-2
Supervisor					
Khodamoradi, Kamyar	Ph.D.	Algorithms for Scheduling and Routing Problems	Completed	2013-1	2017-3

Current Research Interests

Location Routing Problems in Networks [design and analysis of algorithms, computational geometry, resource allocation optimization, vehicle routing, scheduling, real-time, approximation algorithms]

One of the most important aspects of logistics is deciding where to locate new facilities such as retailers, warehouses or factories. For systems in which deliveries are made along multiple stop routes, the routing problem and the location problem must be considered simultaneously. These strategic decisions are a crucial determinant of whether materials will flow efficiently through the distribution system. Facility location analysis has played a central role in the development of operations research. Location problems encompass a wide range of problems such as the location of emergency services, location of hazardous materials, location of ATM bank machines, problems in telecommunication networks design, etc., just to name a few. My objective is to develop new tools to aid in the location of logistics to optimally serve the demands of customers. My approach is to study the applicability and the extendability of the most advanced theory and techniques, extend the existing techniques, and develop new paradigms to further the state of the art in the area of facility location optimization. [design and analysis of algorithms, computational geometry, resource allocation optimization, vehicle routing, scheduling, real-time, approximation algorithms]

Completed Works

Journal Articles

Robert Benkoczi, Binay Bhattacharya, Yuya Higashikawa, Tsunehiko Kameda, Naoki Katoh: Minsum k-sink problem on path networks. Theor. Comput. Sci. 806: 388-401 (2020)

Binay K. Bhattacharya, Minati De, Subhas C. Nandy, Sasanka Roy: Constant work-space algorithms for facility location problems. Discret. Appl. Math. 283: 456-472 (2020)

Binay Bhattacharya, Sandip Das, Tsunehiko Kameda: Linear-time fitting of a k-step function. Discret. Appl. Math. 280: 43-52 (2020)

Sergey Bereg, Binay Bhattacharya, Sandip Das, Tsunehiko Kameda, Priya Ranjan Sinha Mahapatra, Zhao Song; Optimizing squares covering a set of points, Theor. Comput. Sci. 729: 68-83 (2018).

Binay Bhattacharya, Minati De, Anil Maheshwari, Subhas Nandy, Sasanka Roy, Rectilinear path problemsin restricted memory setup, Discrete Applied Mathematics, 228:80-87 (2017).

Sandip Banerjee, Bhargav Bhattacharya, Binay Bhattacharya, Arindam Biswas, Sandip Das, Ritankar Mandal, Sasanka Roy, On representing a simple polygon perceivable to a blinf person, Information Processing Letters, 120:1-5 (2017).

Ante Custic, Vladyslav Sokol, Abraham Punnen, Binay Bhattacharya, The bilinear assignment problem: complexity and polynomially solvable special cases, Mathematical Programming 166(1-2):185-202 (2017).

Conference Proceedings

Binay Bhattacharya, Sandip Das, Subhadeep Ranjan Dev: The Weighted k-Center Problem in Trees for Fixed k. ISAAC 2019: 27:1-27:11

Binay Bhattacharya, Sandip Das, Subhadeep Ranjan Dev, The weighted k-center problem in trees for fixed k, ISAAC: 27:1-27:11 (2019)

Robert Benkoczi, Binay Bhattacharya, Yuya Higashikawa, Tsunehiko Kameda, Naoki Katoh, Minmax-Regret Evacuation Planning for Cycle Networks, TAMC 42-58 (2019)

Binay Bhattacharya, Yuya Higashikawa, Tsunehiko Kameda, Naoki Katoh, An O(n^2 log^2 n) Time Algorithm for Minmax Regret Minsum Sink on Path Networks, ISSAC 14:1- 14:13 (2018).

Robert Benkoczi, Binay Bhattacharya, Yuya Higashikawa, Tsunehiko Kameda, Naoki Katoh, Minsum k-Sink Problem on Dynamic Flow Path Networks, IWOCA 78-89 (2018).

Binay Bhattacharya, Mordecai J. Golin, Yuya Higashikawa, Tsunehiko Kameda, Naoki Katoh: Improved Algorithms for Computing k-Sink on Dynamic Flow Path Networks. WADS: 133-144 (2017).

Binay Bhattacharya, Lily Li, Minimum enclosing circle problem with a base point, CCCG, 50-55 (2017).

Yasutaka Furukawa

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School of Computing Science
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http://www.cs.sfu.ca/~furukawa

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Honors and Awards

- **PAMI Longuet-Higgins Prize at CVPR** (2020)
- **CS-CAN: Outstanding Young CS Researcher Award** (2018)
- **NSF CAREER Award** (2015).

Funding

- Yasutaka Furukawa: DND/NSERC Discovery Grant Supplement. Solving Indoor Mapping and Navigation. 2018.8 - 2021.7. $120,000.
- Yasutaka Furukawa: NSERC Discovery Grants Program - Accelerator Supplements. Solving Indoor Mapping and Navigation. 2018.4 - 2021.3. $120,000.
- Yasutaka Furukawa: NSERC Discovery Grants. Solving Indoor Mapping and Navigation. 2018.4 - 2023.3. $240,000.
- Creation of Operationally Realistic 3D Environment (CORE3D), IARPA. 2018-2019. USD349,453.
- Yasutaka Furukawa: National Science Foundation. RI: Small: Functional Object Modeling (IIS 1618685). 06/01/16 - 05/31/19. USD488,868.
- Yasutaka Furukawa: National Science Foundation. CAREER: Structured Indoor Modeling (IIS 1540012). 2/1/2015 - 1/31/2020. USD487,821.

Conference Papers

- Nelson Nauata and Yasutaka Furukawa
  Vectorizing World Buildings: Planar Graph Reconstruction by Primitive Detection and Relationship Inference
  European Conference on Computer Vision 2020.
- Nelson Nauata, Kai-Hung Chang, Chin-Yi Cheng, Greg Mori, and Yasutaka Furukawa
  House-GAN: Relational Generative Adversarial Networks for Graph-constrained House Layout Generation
  European Conference on Computer Vision 2020 (oral).
- Yiming Qian and Yasutaka Furukawa
  Learning Inter-Plane Relations for Piecewise Planar Reconstruction
  European Conference on Computer Vision 2020.
- Fuyang Zhang, Nelson Nauata, and Yasutaka Furukawa
  Conv-MPN: Convolutional Message Passing Neural Network for Structured Outdoor

Architecture Reconstruction
Computer Vision and Pattern Recognition, 2020.

- Huayi Zeng, Kevin Joseph, Adam Vest, and Yasutaka Furukawa
  Bundle Pooling for Polygonal Architecture Segmentation Problem
  Computer Vision and Pattern Recognition, 2020.
- Jiacheng Chen, Chen Liu, Jiaye Wu, and Yasutaka Furukawa
  Floor-SP: Inverse CAD for Floorplans by Sequential Room-wise Shortest Path
  International Conference on Computer Vision, 2019.
- Chen Liu, Kihwan Kim, Jinwei Gu, Yasutaka Furukawa, and Jan Kautz
  PlaneRCNN: 3D Plane Detection and Reconstruction from a Single Image
  Computer Vision and Pattern Recognition, 2019 (oral).

Professional Activities

Associate Editor	IEEE Transactions on Pattern Analysis and Machine Intelligence November 2019 -.
Associate Editor	International Journal of Computer Vision, Springer, December 2016 -.
Area Chair	Computer Vision and Pattern Recognition, 2020, 2018, 2017 International Conference on Computer Vision, 2019, 2017, 2015 European Conference on Computer Vision, 2020
Program Chair	ICCV 2023 3DV 2017 3DV 2013 (the third joint 3Dim/3DPVT)

Students/Postdocs Advised or co-Advised

- Sepid Hosseini (Ph.D.) at Simon Fraser University. 2020 - Current.
- Saghar Irandoust (Master) at Simon Fraser University. 2020 - Current.
- Yiming Qian (Postdoc) at Simon Fraser University. 2019 - Current.
- Pyojin Kim (Postdoc) at Simon Fraser University. 2019 - Current.
- Weilian Song (Master) at Simon Fraser University. 2019 - Current.
- Kevin Joseph (Master) at Simon Fraser University. 2019 - Current.
- Mohammad Amin Shabani (Ph.D.) at Simon Fraser University 2019 - Current.
- Mahsa Abyaneh (Master) at Simon Fraser University. 2018 - Current.
- Adam Patrick (Fulbright scholar) at Simon Fraser University. 2018 - Current.
- Nelson Nauata (Ph.D.) at Simon Fraser University. 2018 - Current.
- Sachini Herath (Master) at Simon Fraser University. 2017 - Current.
- Huayi Zeng (Ph.D.) at Washington University in St. Louis. 2016 - Current.
- Hang Yan (Ph.D.) at Washington University in St. Louis. 2014 - 2019.
- Chen Liu (Ph.D.) at Washington University in St. Louis. 2014 - 2019.
- Satoshi Ikehata (Postdoc) at Washington University in St. Louis

Curriculum Vitae – 7 years

Greg Mori
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Fax: +1 (778) 782 3045

1 Background

1.1 Education

2004 Ph.D. in Computer Science
Department of Electrical Engineering and Computer Sciences
University of California at Berkeley
Thesis: Detecting and Localizing Human Figures
Advisor: Jitendra Malik

1999 Hon. B.Sc. in Computer Science and Mathematics with High Distinction
University of Toronto

1.2 Employment History

06/2018 - current Research Director
RBC Borealis AI Vancouver

09/2015 - current Professor
School of Computing Science, Simon Fraser University

05/2015 - 04/2018 Director
School of Computing Science, Simon Fraser University

12/2014 - 05/2015 Visiting Scientist
Google Inc., Mountain View, CA

09/2010 - 08/2015 Associate Professor
School of Computing Science, Simon Fraser University

1.3 Awards since 2013

ICCV Helmholtz Prize, IAPR MVA Most Influential Paper over the Decade Award, Discovery Accelerator Supplement, Award for Service to the Research Community

2 Research

2.1 Research Program

My research is in computer vision, and is concerned with developing algorithms that automatically interpret images and videos, particularly those containing people.

2.2 Most Significant Research Contributions

Human Action Recognition, Human Pose Estimation, Breaking Visual CAPTCHAs, Applications of Vision-based Activity Monitoring

2.3 Publications

A complete list of publications can be found here https://www.cs.sfu.ca/~mori/mori_cv.pdf

3 Teaching

3.1 Award

Excellence in Undergraduate Teaching Award 2006

This award is handed out annually by the SFU Undergraduate Computing Science Student Society (CSSS) to Computing Science faculty to recognize their efforts in teaching undergraduate courses in our department. I received this award in 2006.

3.2 Graduate Student Supervision

Summary of graduate student senior supervisory duties:

Ph.D.		M.Sc.		Total
Active	Complete	Active	Complete	
11	11	2	34	58

3.3 Undergraduate Student Supervision

I have supervised research projects by undergraduate students working under the NSERC Undergraduate Student Research Award (USRA) program, directed studies courses (CMPT 415/416), and directly via research assistantships (RA).

3.4 Course Teaching at Simon Fraser University

For each of my courses I maintain a webpage with lecture slides, homework assignments, and other course material. These webpages are linked from my webpage: `http://www.cs.sfu.ca/~mori`.

3.5 Other Teaching

- Statistical and Structural Recognition of Human Actions: Tutorial at European Conference on Com- puter Vision (ECCV) 2010, Ivan Laptev and Greg Mori
- Emerging Topics in Human Activity Recognition: Tutorial at Computer Vision and Pattern Recognition (CVPR) 2014, Michael Ryoo, Ivan Laptev, Sangmin Oh, and Greg Mori

Ali Mahdavi-Amiri

PERSONAL INFORMATION
Position: University Research Associate, Simon Fraser University, Canada.
Citizenship: Canadian.

CONTACT INFORMATION
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School of Computing Science
Simon Fraser University

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Email: amahdavi@sfu.ca

EDUCATION

- Ph.D. in Computer Science, University of Calgary, 2015.
- M.Sc. in Computer Science, Sharif University of Technology, 2009.
- B.Eng. in Software Engineering, Ferdowsi University of Mashhad, 2006.

RESEARCH INTERESTS
Computer Graphics, Digital Fabrication, Machine Learning, Spatial Data Structures.

SELECTED AWARDS AND GRANTS

- NSERC Postdoctoral Fellowship, 90,000$ for two years, 2016.
- J.B. Hyne Research Innovation Award, Granted to up to four graduate students each year in the entire university, 2014.
- Michael A. J. Sweeney Award, Graphics Interface 2013, Best Student Paper, 2013.
- Departmental Research Award, 2012.
- Departmental Teaching Excellence Award, for CPSC 413, Algorithm Design, 2011.

SELECTED JOURNAL PUBLICATIONS

1. **Mahdavi-Amiri, A.**, Yu, F., Zhao, H., Schulz, A., Zhang, H., "VDAC: Volumetric Decompose-and-Carve for Subtractive Manufacturing", *ACM Transactions on Graphics*, [Proceedings of SIGGRAPH Asia (Under Submission)], 2020.
2. Wang, X., Xu, Y., Xu, K., Tagliasacchi, A., Zhou, B., **Mahdavi-Amiri, A.**, Zhang, H., "PIE-Net: Learning Parametric Inference of Edges for Point Clouds", *ACM Transactions on Graphics*, [Proceedings of NeurIPS (Under Submission)], 2020.
3. Alderson, T., **Mahdavi-Amiri, A.**, and Samavati, F.F., "RIAS: Repeated Invertible Averaging for Surface Multiresolution of Arbitrary Degree", *IEEE Transactions on Visualization and Computer Graphics (TVCG)*, 2020.
4. **Mahdavi-Amiri, A.**, Alderson, T., and Samavati, F.F., "Geospatial Data Organization Methods with Emphasis on Aperture 3 Hexagonal Discrete Global Grid Systems.", *Cartographica*, 2019.
5. Li, S., **Mahdavi-Amiri, A.**, Liu, H., Hu, R., Van Kaick, O., Huang, H., Zhang, H., "Design and Fabrication of Reversible Shapes", *ACM Transactions on Graphics*, [Proceedings of SIGGRAPH Asia], 2018.
6. Yu, F., Zhang, Y., Xu, K., **Mahdavi-Amiri, A.**, Zhang, H., "Semi-Supervised Co-Analysis of 3D Shape Styles from Projected Lines", *ACM Transactions on Graphics*, 2018.
7. Kamyar Allahverdi, Hessam Djavaherpour, **Mahdavi-Amiri, A.**, and Samavati, F.F., "Landscaper: A Modeling System for 3D Printing Scale Models of Landscapes", *Computer Graphics Forum*, 2018.
8. Alderson, T., **Mahdavi-Amiri, A.**, and Samavati, F.F., "Spherical Curve Offsetting in the Vector and Raster Space", *The Visual Computer*, [Proceedings of CGI]., 2018.
9. Djavaherpour, H., **Mahdavi-Amiri, A.**, and Samavati, F.F., "Physical Visualization of Geospatial Datasets", *IEEE Computer Graphics and Applications* (Special Issue on Computational Design and Fabrication Meet Computer Graphics), 2017.
10. Bartels, R., **Mahdavi-Amiri, A.**, and Samavati, F.F., "Diagrammatic Approach for Constructing Multiresolution of Primal Subdivisions", *Computer Aided Geometric Design*, 2017.
11. Alderson, T., **Mahdavi-Amiri, A.**, and Samavati, F.F., "Multiresolution on Spherical Curves", *Graphical Models*, 2016.
12. **Mahdavi-Amiri, A.**, Harrison, E., and Samavati, F.F., "Hierarchical Grid Conversion", *Computer Aided Design*, 2016.

13. **Mahdavi-Amiri, A.**, Alderson, T., and Samavati, F.F., "A Survey of Digital Earth", *Computers & Graphics*, 2016.[**Invited for Oral Presentation in GI 2016**], [**Used as a Reference for OGC Standard on DGGS**].
14. **Mahdavi-Amiri, A.**, Harrison, E., and Samavati, F.F., "Hexagonal Connectivity Maps for Digital Earth", *International Journal of Digital Earth*, 2015. (Impact Factor: 2.212)
15. **Mahdavi-Amiri, A.**, and Samavati, F.F., "Atlas of Connectivity Maps", *Computers & Graphics*, 2014.
16. **Mahdavi-Amiri, A.**, Peterson, P., and Samavati, F.F., "Categorization and Conversions for Indexing Methods of Discrete Global Grid Systems", *ISPRS International Journal of Geoinformation* , 2014.

SELECTED CONFERENCE PUBLICATIONS

1. Hosseini,V., Alim, U., **Mahdavi-Amiri, A.**, Oehlberg, L., Taron, J.,"Portal: Design and Fabrication of Incidence-Driven Screens", SMI FASE, 2020.
2. Jubair, M., Alim, U., Roeber, N., Clyne, J., and **Mahdavi-Amiri, A.**, "Icosahedral Maps for a Multiresolution Representation of Earth Data", *21st International Symposium of Vision, Modelling, and Visualization (VMV)*, 2016.
3. **Mahdavi-Amiri, A.**, Whittingham, P., and Samavati, F.F., "Cover-it: An Interactive System for Covering 3D Printed Objects", *Graphics Interface*, 2015.
4. **Mahdavi-Amiri, A.**, and Samavati, F.F., "ACM: Atlas of Connectivity Maps for Semiregular Models", *Graphics Interface*, 2015. [**Best Student Paper Award**].
5. **Mahdavi-Amiri, A.**, Bhojani, F., and Samavati, F.F., "One-to-Two Digital Earth", *9th International Symposium on Visual Computing*, 2013.
6. **Mahdavi-Amiri, A.**, and Samavati, F.F., "Connectivity Maps for Subdivision Surfaces", *GRAPP*, 2012. [Full Paper, Acceptance Rate: 17%]

PROFESSIONAL SERVICES

University Services

- Professional Master's Program, 2019-Present
  Committee Member, Simon Fraser University.
- Graduate Students' Association (GSA), 2011-2012
  Committee Member, University of Calgary.

Program Committee

- Graphic Interface (GI) 2019, 2020.
- Canadian Conference on Artificial Intelligence (AI) 2019, 2020.

Editorial Board, Conference Chairing, and Organization

- International Geometry Summit, 2019.
  Local Organization Chair.
- Big Earth Data Journal, 2019; Manual of Digital Earth, 2018.
  Guest Editor.

Paper Review

- Several high quality journals and conferences including SIGGRAPH, SIGGRAPH Asia, Eurographics, Graphics Interface, Computers & Graphics, The Visual Computer, etc.

TEACHING

Instructor

- Practices in Visual Computing I, Fall 2019.
  Simon Fraser University.
- Practices in Visual Computing II, Spring 2019, 2020.
  Simon Fraser University.
  Latest Students' Evaluation.
- Algorithm Concepts, Fall 2017-2019, , Spring 2018, 2019, Summer 2018.
  New York Institute of Technology.
- Modelling for Computer Graphics, Fall 2015.
  University of Calgary.

Teaching Assistant

- Several courses including Modeling for Computer Graphics, Computer Graphics, Design and Analysis of Algorithms I, Techniques for Numerical Computations, etc.

Curriculum Vitae

Manolis Savva
Assistant Professor
School of Computing Science
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8888 University Drive, Burnaby, BC V5A 1S6, Canada
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http://www.cs.sfu.ca/~msavva

1 Education

2016 Ph.D. in Computer Science, Department of Computer Science, Stanford University
Thesis: Body-centric Understanding of 3D Environments, *Advisor:* Pat Hanrahan

2012 M.Sc. in Computer Science, Stanford University

2009 B.A. in Physics and Computer Science, Cornell University

2 Employment History

01/2019 - current Assistant Professor, School of Computing Science, Simon Fraser University

07/2018 - 08/2020 Visiting Researcher, Facebook AI Research, Menlo Park, CA

09/2017 - 07/2018 Research Engineer Contractor, AutoRoboto LLC, on-site at Google, Mountain View, CA

09/2017 - 09/2018 Visiting Research Collaborator, Princeton University, Princeton, NJ

08/2016 - 08/2017 Postdoctoral Research Associate, Princeton University, Princeton, NJ

09/2013 - 12/2013 Research Intern, Advanced Technologies Division, Square Enix Co., Ltd., Tokyo, Japan.

05/2009 - 05/2010 Research Assistant, Program of Computer Graphics, Cornell University, Ithaca, NY.

08/2007 - 04/2009 Research Assistant, Lab of Atomic and Solid State Physics, Cornell University, Ithaca, NY.

3 Selected Publications

Legend: [J] Refereed journal papers, [C] Refereed conference papers, [N]: Non-refereed publications, * indicates equal contribution.

[J2] A. Kadian*, J. Truong*, A. Gokaslan, A. Clegg, E. Wijmans, S. Lee, M. Savva, S. Chernova, D. Batra. Are We Making Real Progress in Simulated Environments? Measuring the Sim2Real Gap in Embodied Visual Navigation. *Robotics and Automation Letters (RA-L) & IROS 2020*

[J1] R. Hu*, M. Savva*, O. van Kaick*. Functionality Representations and Applications for Shape Analysis. *Eurographics STAR, Computer Graphics Forum 2018*

[C9] C. Chen, S. Hu, P. Nikdel, G. Mori, M. Savva. Relational Graph Learning for Crowd Navigation. *IROS 2020*

[C8] E. Wijmans, A. Kadian, A. Morcos, S. Lee, I. Essa, D. Parikh, M. Savva, D. Batra. Decentralized Distributed PPO: Solving PointGoal Navigation. *ICLR 2020*

[C7] M. Savva*, A. Kadian*, O. Maksymets*, Y. Zhao, E. Wijmans, B. Jain, J. Straub, J. Liu, V. Koltun, J. Malik, D. Parikh, D. Batra. Habitat: A Platform for Embodied AI Research. *ICCV 2019, Best Paper Award Nomination*

[C6] K. Wang, Y. Lin, B. Weissmann, A. X. Chang, M. Savva, D. Ritchie. PlanIT: Planning and Instantiating Indoor Scenes with Relation Graph and Spatial Prior Networks. *SIGGRAPH 2019*

[C5] A. Chang, A. Dai, T. Funkhouser, M. Halber, M. Nießner, M. Savva, S. Song, A. Zeng, Y. Zhang. Matterport3D: Learning from RGB-D Data in Indoor Environments. *3DV 2017*

[C4] A. Dai, A. X. Chang, M. Savva, M. Halber, T. Funkhouser, M. Nießner. ScanNet: Richly-annotated 3D Reconstructions of Indoor Scenes. *CVPR 2017*

[C3] M. Savva, A. X. Chang, P. Hanrahan, M. Fisher, M. Nießner. PiGraphs: Learning Interaction Snapshots from Observations. *SIGGRAPH 2016*

[C2] M. Savva, A. X. Chang, P. Hanrahan, M. Fisher, and M. Nießner. SceneGrok: Inferring Action Maps in 3D environments. *SIGGRAPH Asia 2014*

[C1] M. Savva, N. Kong, A. Chhajta, L. Fei-Fei, M. Agrawala, and J. Heer. ReVision: Automated Classification, Analysis and Redesign of Chart Images. *UIST 2011, Notable Paper Award*

[N1] A. X. Chang, T. Funkhouser, L. Guibas, P. Hanrahan, Q. Huang, Z. Li, S. Savarese, M. Savva, S. Song, H. Su, J. Xiao, L. Yi, and F. Yu. ShapeNet: An Information-Rich 3D Model Repository. *arXiv:1512.03012 [cs.GR], Dec 2015*

4 Research Funding

The following summary table shows research funding for which I was a principal investigator.

	Type	Source	Awarded	End	Annual	Total
G5	Equipment	CFI/BCKDF	2020	2023	$100,000	$300,000
G4	Operating	Facebook AI Research	2019	2020	$30,000	$30,000
G3	Operating	NSERC-DG	2019	2024	$39,000	$195,000
G2	Operating	NSERC-DG	2019	2019	$12,500	$12,500
G1	Operating	SFU-PRG	2019	2024	$54,000	$270,000

Total: $507,500 Operating + $300,000 Equipment

5 Teaching and Supervision

Summary of SFU teaching with final enrollments

Legend: 1 - Spring trimester (Jan to Apr); 2 - Summer trimester (May to Aug); 3 - Fall trimester (Sep to Dec)

		2019			Totals	
	Course	1	2	3	UG	Grad
(1)	CMPT 757			25	1	24
	Grand totals:				1	24

Course descriptions

1. **CMPT 757 - Frontiers of Visual Computing**: This is a core course for the visual computing specialization of the Professional Masters degree, which I developed and offered in Fall of 2019. The course is intended to provide a graduate student-level introduction to a spectrum of subfields in visual computing, and their impact in a variety of application domains. Students are exposed to state-of-the-art research in a breadth of topics spanning computer vision, computer graphics, human-computer interaction, and visualization.

Summary of graduate student senior supervisory duties

Ph.D.		M.Sc.	
Active	Complete	Active	Complete
3	0	3	0

Mo Chen

Assistant Professor
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ASB 9971-8888 University Drive
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Distal Fellow, NSERC Canadian Robotics Network
mochen@cs.sfu.ca

Education

Stanford University, Stanford, CA, USA

Postdoctoral Researcher, Aeronautics and Astronautics, 2017/08 – 2018/07
- Advisor: Marco Pavone

University of California, Berkeley, Berkeley, CA, USA

Ph. D., Electrical Engineering and Computer Science, 2011/08 – 2017/07
- Advisor: Claire Tomlin

University of British Columbia, Vancouver, BC, Canada

B. A. Sc., Engineering Physics (EE option), Mathematics Minor, 2006/09 – 2011/06

Research Interests

- **Theory**: formal verification, reachability analysis, system decomposition, parallel computing, verification and machine learning, game theory
- **Applications**: multi-agent robotic systems, safety-critical systems, human-robot interactions, human intent inference, assistive technology, UAS traffic management, internet of things

Teaching and Advising

Teaching

- CMPT 419/726: Machine Learning – Spring 2020
- CMPT 125: Introduction to Computing Science and Programming II – Spring 2020
- CMPT 894: Directed Reading in Deep Reinforcement Learning – Spring 2020
- CMPT 419/983: Robotic Autonomy: Algorithms and Computation – Fall 2019
- CMPT 125: Introduction to Computing Science and Programming II – Spring 2019
- CMPT 882: Special Topics in Artificial Intelligence: Robotic Decision Making – Spring 2019

Advising

- I direct the SFU Multi-Agent Robotic Systems (MARS) lab, whose research focuses combining traditional analytical methods in robotics and modern data-driven techniques.
- The SFU MARS Lab is home to 9 PhD, 5 MSc, and 4 undergraduate students

Recent Grants

- NSERC Discovery ($140,000 over 5 years) and Discovery Launch Supplement ($12,500 over 1 year)
- Huawei-SFU Visual Computing Joint Lab ($200,000 over 2 years)
- Canada's Digital Technology Supercluster with Terramera Inc. ($182,000 over 2 years), in collaboration with Martin Ester and Ghassan Hamarneh
- CFI John R. Evans Leaders Fund ($750,000), in collaboration with Manolis Savva

Recent Invited Talks

- Mo Chen, "Optimal Control and Machine Learning in Robotics," Workshop on High Dimensional Hamilton-Jacob Method in Control and Differential Games, Institute for Pure & Applied Mathematics, University of California, Los Angeles, Los Angeles, California, March 30 - April 3, 2020
- Mo Chen, "Optimal Control and Machine Learning in Robotics," *NSERC Canadian Robotics Network Distal Fellow seminar*, by video conference from Vancouver, BC, Jan. 9, 2020.
- Mo Chen, "Robotic Safety and Reinforcement Learning," *University of Melbourne Electrical and Electronics Engineering invited seminar*, Melbourne, VIC, Australia, Aug. 7, 2019.
- Mo Chen, "Reachability-Based Robotic Safety and Reinforcement Learning," *Alberta Machine Intelligence Institute (Amii) invited seminar*, Edmonton, AB, Apr. 25, 2019.
- Mo Chen, "Safety in Autonomy via Reachability," *Stanford Robotics Seminar*, Stanford, CA, USA, May 18, 2018.
- Mo Chen, "Differential Games: Practical Safety-Critical Applications," *The Center for Information Technology Research in the Interest of Society (CITRIS)/CITRIS People and Robots (CPAR) Control Theory and Automation Symposium*, Santa Cruz, CA, USA, Apr. 27, 2018.

Selected Publications

[J1] Mo Chen, Sylvia L. Herbert, Haimin Hu, Ye Pu, Jaime Fisac, Somil Bansal, SooJean Han, Claire J. Tomlin. "FaSTrack: a Modular Framework for Real-Time Motion Planning and Guaranteed Safe Tracking." *IEEE Transactions on Automatic Control*, to appear.

[J2] Sandeep P. Chinchali, Scott C. Livingston, Mo Chen, Marco Pavone, "Multi-objective optimal control for proactive decision-making with temporal logic models," *International Journal of Robotics Research*, 2019.

[C1] Seth Siriya, Minh Bui, Arrvindh Shriraman, Mo Chen, Ye Pu, "Safety-Guaranteed Real-Time Trajectory Planning for Underwater Vehicles in Plane-Progressive Waves," *IEEE Conference on Decision and Control*, 2020.

[C2] Xubo Lyu, Mo Chen, "TTR-Based Rewards for Reinforcement Learning with Implicit Model Priors," *IEEE/RSJ International Conference on Intelligent Robots and Systems*, 2020.

[C3] Payam Nikdel, Mo Chen, Richard Vaughan, "Recognizing and Tracking High-Level, Human-Meaningful Navigation Features of Occupancy Grid Maps," *Proceedings of the Conference on Computer and Robot Vision*, 2020.

[C4] Anjian Li, Somil Bansal, George Giovanis, Varun Tolani, Claire J. Tomlin, Mo Chen, "Generating Robust Supervision for Learning-Based Visual Navigation Using Hamilton-Jacobi Reachability," *Proceedings of the Learning for Dynamics and Control Conference*, 2020.

[C5] Juan Chacon, Mo Chen, Razvan C. Fetecau, "Safe Coverage of Compact Domains For Second Order Dynamical Systems," *Proceedings of the IFAC World Congress*, 2020.

[C6] Anjian Li, Mo Chen, "Guaranteed-Safe Approximate Reachability via State Dependency-Based Decomposition," *Proceedings of the American Control Conference*, 2020.

Mohamed Hefeeda

EDUCATION

2004	Ph.D.	Computer Science, Purdue University, West Lafayette, IN, USA
1997	M.Sc.	Automatic Control Engineering, Mansoura University, Mansoura, Egypt
1994	B.Sc.	Electronics Engineering, Mansoura University, Mansoura, Egypt

EMPLOYMENT HISTORY

May 2018 - Current	Director, School of Computing Science, Simon Fraser University
September 2014 - Current	Professor, School of Computing Science, Simon Fraser University
September 2010 - August 2014	Associate Professor, School of Computing Science, Simon Fraser University
September 2004 - August 2010	Assistant Professor, School of Computing Science, Simon Fraser University

RESEARCH INTERESTS

- Multimedia Networking
- Mobile Computing
- Distributed and Cloud Computing
- Immersive Video Processing and Delivery

AWARDS AND HONORS

- Best Student Paper Award, ACM Multimedia Systems Conference, March 2019
- Best Student Paper Award—Runner Up, ACM Multimedia Systems Conference, March 2018
- Best Paper Award, ACM Multimedia Systems Conference, March 2015
- Best Associate Editor, ACM Transactions on Multimedia on Multimedia Computing, Communications, and Applications (TOMM), October 2014
- NSERC DAS (Discovery Accelerator Supplements) Award, 2011
- Best Technical Demonstration Award from the ACM Multimedia Conference, October 2008
- Best Paper Award, IEEE Innovations Conference, December 2008
- Distinguished Graduate Award, Syndicate of Egyptian Engineers, 1994
- Distinguished Undergraduate Award, Faculty of Engineering, Mansoura University, Egypt, five times (1989—1994)

RESEARCH FUNDING

- More than 20 funded research projects from national and international organizations as well as industry, such as NSERC, IARPA (US), Qatar National Research Fund, Nokia, Cisco, Huawei, and AMD
- Funded projects included multiple NSERC Strategic, CRD, and Discovery grants
- Total research funding received: $4.3+M

SUPERVISED POST DOC AND GRADUATE STUDENTS

- 6 postdocs, 6 PhDs, 30 Master's
- Most students and post docs landed academic or industry jobs at companies such as Google, Microsoft, Adobe, and Amazon.

PUBLICATIONS

Refereed Journals …….....	38
Refereed Conferences and Workshops ……	73
Invited Book Chapters ……	3
Refereed Magazines ……	2
Refereed Posters and Demos ……..	9
Granted Patents……	4
Total …… ……..	**129**

Sample Publications

[1] O. Eltobgy, O. Arafa, and M. Hefeeda, Mobile Streaming of Live 360-Degree Videos, *IEEE Transactions on Multimedia*, Accepted February 2020.

[2] K. Calagari, M. Elgharib, P. Didyk, A. Kaspar. W. Matusik, and M. Hefeeda, Data Driven 2D-to-3D Video Conversion for Soccer, *IEEE Transactions on Multimedia,* 20(3):605—619, March 2018.

[3] H. Hong, T. El-Ganainy, C. Hsu, K. Harras, and M. Hefeeda, Disseminating Multi-Layer Multimedia Content over Challenged Networks, *IEEE Transactions on Multimedia,* 20(2):345—360, February 2018.

[4] S. Almowuena and M. Hefeeda, Mobile Video Streaming over Dynamic Single-Frequency Networks, *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM)*, 12(5s), Article 81, pp:1—23, December 2016

[5] S. Almowuena, M. Rahman, C. Hsu, A. Hassan, and M. Hefeeda, Energy-aware and Bandwidth-efficient Hybrid Video Streaming over Mobile Networks, *IEEE Transactions on Multimedia*, 18(1):102—115, January 2016.

[6] M. Hefeeda, T. ElGamal, K. Calagari, and A. Abdelsadek, Cloud-Based Multimedia Content Protection System, *IEEE Transactions on Multimedia*, 17(3):420—433, March 2015.

[7] F. Tabrizi, J. Peters, and M. Hefeeda, Dynamic Control of Receiver Buffers in Mobile Video Streaming Systems, *IEEE Transactions on Mobile Computing*, 12(5), pp. 995—1008, May 2013.

[8] N. Sharma and M. Hefeeda, Hyperspectral Reconstruction from RGB Images for Vein Visualization, *in Proc. of ACM Multimedia Systems (MMSys'20)*, Istanbul, Turkey, June 2020.

[9] M. Arab, K. Calagari, and M. Hefeeda, Band and Quality Selection for Efficient Transmission of Hyperspectral Images, *In Proc. of ACM Multimedia Conference (MM'19)*, Nice, France, October 2019.

[10] M. Hegazy, K. Diab, M. Saeedi, B. Ivanovic, I. Amer, Y. Liu, G. Sines, and M. Hefeeda, Content-aware Video Encoding for Cloud Gaming, *In Proc. of the ACM Multimedia Systems (MMSys'19)*, Amherst, MA, June 2019. **(Best Student Paper Award)**

[11] K. Diab and M. Hefeeda, Joint Content Distribution and Traffic Engineering of Adaptive Videos in Telco-CDNs, *In Proc. of IEEE INFOCOM 2019*, Paris, France, April 2019.

[12] K. Calagari, M. Elgharib, S. Shirmohammadi, and M. Hefeeda, Sports VR Content Generation from Regular Camera Feeds, *ACM Multimedia Conference (MM'17)*, pp. 699—707, Mountain View, CA, October 2017.

[13] A. Nandoriya, M. Elgharib, C. Kim, M. Hefeeda, and W. Matusik, Video Reflection Removal Through Spatio-Temporal Optimization, *International Conference on Computer Vision (ICCV'17)*, pp. 2430—2438, Venice, Italy, October 2017.

[14] P. Kellnhofer, P. Didyk, K. Myszkowski, M. Hefeeda, H. Seidel, W. Matusik, GazeStereo3D: Seamless Disparity Manipulations, *In Proc. of ACM SIGGRAPH'16*, Anaheim, CA, July 2016.

[15] M. ElGharib, M. Hefeeda, F. Durand, and B. Freeman, Video Magnification in Presence of Large Motions, *In Proc. of IEEE Conference on Computer Vision and Pattern Recognition (CVPR'15)*, Boston, MA, June 2015.

[16] K. Templin, P. Didyk, K. Myszkowski, H.-P. Seidel, M. M. Hefeeda, W. Matusik, Modeling and Optimizing Eye Vergence to Stereoscopic Cuts, *In Proc. of ACM SIGGRAPH 2014*, Vancouver, Canada, August 2014.

Hao (Richard) Zhang

CONTACT INFORMATION	School of Computing Science Simon Fraser University (SFU)	*E-mail:* haoz@cs.sfu.ca *URL:* http://www.cs.sfu.ca/~haoz

RESEARCH

Graphics, geometric modeling and 3D content creation, shape analysis, and machine learning.

EDUCATION

- PhD, Department of Computer Science, University of Toronto, 2003.
- Master of Math., Department of Computer Science, University of Waterloo, 1997.
- Bachelor of Math., Faculty of Mathematics, University of Waterloo, 1995.

EMPLOYMENT & APPOINTMENT

- 09/2014 - now: Professor, School of Computing Science, SFU
- 10/2016 - 02/2017: Visiting Professor, Dept. of Computer Science, Stanford University, USA
- 01/2003 - 08/2014: Assistant and then Associate Professor with tenure, SFU

SELECTED AWARDS AND RECOGNITIONS

- Distinguished SFU Professor (equivalent to University Professor), 2020-2025.
- Google Faculty Research Award, 2019-20.
- Best Student Paper Award, CVPR 2020, first-authored by PhD student Zhiqin Chen.
- Best Paper Awards and other paper recognitions: Symposium on Geometry Processing (SGP) 2008; CAD/Graphics 2017; two papers selected to be featured in press release: SIGGRAPH Asia 2019 and SIGGRAPH 2017; 6 out of 100+ papers were selected per conference.
- "AI2000 Most Influential Scholar Honorable Mention", ranked #13 out of the top 100 computer graphics researchers, by AMiner, 2020. The recognition "names 2,000 of the world's top-cited research scholars from the fields of artificial intelligence" over the ten-year period, 2009-2019.
- 2014 NSERC Discovery Accelerator Supplement (DAS) Award.

SELECTED PROFESSIONAL SERVICES

- Associate Editor-in-chief: IEEE Computer Graphics & Applications, 2019 -.
- Editor-in-chief: Computer Graphics Forum, 2014-2018.
- Program/conference chairs: International Geometry Summit 2019; SIAM Conference on Geometric Design 2019; Graphics Interface 2015 & 2021; SIGGRAPH Asia Course 2014; Eurographics/ACM Symposium on Geometry Processing (SGP) 2013, etc.
- Program Committee: SIGGRAPH 2012-13, 2016-17, 2021; SIGGRAPH Asia 2012-13, 2017-18, 2020; SIGGRAPH Asia Paper Sort Committee 2019; Eurographics 2014-16, 2018-19, 2021.

RESEARCH FUNDING

- Totaling $2.2+ million, all personal portion.

SELECTED KEYNOTE AND INVITED TALKS

- "Learning Generative Models of 3D Shapes: From Implicit Functions to Structured Representations", keynote at ChinaGraph 2020, and invited talk at PKU, etc.
- "Can Machines Learn to Generate 3D Shapes?": keynote at SGP 2019, Computer Graphics International (CGI) 2018, and CAD/Graphcis 2017.
- "From Symmetry to Functionality: An Evolution to Understand 3D Shapes", keynote at Shape Modeling International (SMI) 2018, and invited talks at Stanford, Adobe, Autodesk, etc.

- "New Geometry Problems in Computational Design and Fabrication": keynote talk at Canadian Conference on Computational Geometry (CCCG) 2016, Vancouver, Canada, 2016.

GRADUATE STUDENT SUPERVISION

- Current supervision: 2 postdocs; 7 PhDs; 2 MScs.
- Completed supervision: 3 postdocs; 10 PhDs; 18 MScs.
- Awards won by students: Alain Fournier Award for Best PhD Thesis in Computer Graphics in Canada (2015); four Best Paper Awards; Asia Graphics Young Researcher Award (2019); Excellent Young Researcher Award in China (2016), etc.

PUBLICATION SUMMARY

- Top-tier graphics (SIGGRAPH+Asia) and vision (CVPR/ICCV/ECCV) papers: 70+.
- Total number of refereed journal and conference publications: 160+. H-index: 49.

SELECTED PUBLICATIONS

Selected top-tier papers (2019-20) first-authored by my students:

1. Ali Mahdavi Amiri, Fenggen Yu, Haisen Zhao, Adriana Schulz, and **Hao Zhang**, "VDAC: Volume Decompose-and-Carve for Subtractive Manufacturing", *SIGGRAPH Asia*, 2020.
2. Wallace Lira, Johannes Merz, Daniel Ritchie, Daniel Cohen-or, and **Hao Zhang**, "GANHopper: Multi-Hop GAN for Unsupervised Image-to-Image Translation", *ECCV*, 2020.
3. Jiongchao Jin, Akshay Gadi Patil, Zhang Xiong, and **Hao Zhang**, "DR-KFS: A Differentiable Visual Similarity Metric for 3D Shape Reconstruction", *ECCV*, 2020.
4. Zhiqin Chen, Andrea Tagliasacch, and **Hao Zhang**, "BSP-Net: Generating Compact Meshes via Binary Space Partitioning", *CVPR oral*, **Best Student Paper Award**, 2020.
5. Chenyang Zhu, Kai Xu, Siddhartha Chaudhuri, Li Yi, Leonidas Guibas, and **Hao Zhang**, "AdaSeg: Adaptive Shape Co-Segmentation with Group Consistency Loss", *CVPR oral*, 2020.
6. Kangxue Yin, Zhiqin Chen, Hui Huang, Daniel Cohen-Or, and **Hao Zhang**, "LOGAN: Unpaired Shape Transform in Latent Overcomplete Space", *SIGGRAPH Asia*, 2019.
7. Manyi Li, Akshay Gadi Patil, Kai Xu, Siddhartha Chaudhuri, Owais Khan, Ariel Shamir, Changhe Tu, Baoquan Chen, Daniel Cohen-Or, and **Hao Zhang**, "GRAINS: Generative Recursive Autoencoders for INdoor Scenes", *ACM Trans. on Graphics*, 2019.
8. Zhiqin Chen, Kangxue Yin, Matt Fisher, Siddhartha Chaudhuri, and **Hao Zhang**, "BAE-NET: Branched Autoencoder for Shape Co-Segmentation", *ICCV*, 2019.
9. Zhiqin Chen and **Hao Zhang**, "Learning Implicit Fields for Generative Shape Modeling", *CVPR*, 2019.
10. Wallace Lira, Chi-Wing Fu, and **Hao Zhang**, "Fabricable Eulerian Wires for 3D Shape Abstraction", *SIGGRAPH Asia*, 2018.
11. Chenyang Zhu, Kai Xu, Siddhartha Chaudhuri, Renjiao Yi, and **Hao Zhang**, "SCORES: Shape Composition with Recursive Substructure Priors", *SIGGRAPH Asia*, 2018.
12. Rui Ma, Akshay Gadi Patil, Matthew Fisher, Manyi Li, Soren Pirk, Sai-Kit Yeung, Binh-Son Hua, Xin Tong, Leonadis Guibas, and **Hao Zhang**, "Language-Driven Synthesis of 3D Scene from Scene Databases", *SIGGRAPH Asia*, 2018.
13. Kangxue Yin, Hui Huang, Daniel Cohen-Or, and **Hao Zhang**, "P2P-NET: Bidirectional Point Displacement Net for Shape Transform", *SIGGRAPH*, 2018.

Abbreviated C.V. – Oliver Schulte

Academic Positions

- Current: Professor, School of Computing Science, Simon Fraser University
- Assistant Professor, University of Alberta, 1997-2001

Education

- Ph.D. - Logic and Computation – Carnegie Mellon University 1997
- M.Sc. – Logic and Computation - Carnegie Mellon University 1994
- B.Sc. – Computer Science – University of Toronto 1992

Awards and Selected Grants (last five years)

- Inference, Learning, and Population Size: Projectivity for SRL Models. Manfred Jaeger and Oliver Schulte (2018). *StarAI Workshop @IJCAI.* Best Paper Award.
- Model-based Outlier Detection for Object-Relational Data. Sarah Riahi and Oliver Schulte (2015). *IEEE SSCI 2015,* pp. 1590-1598. Best Student Paper Award.
- NSERC Strategic Project award. Project Title: Reinforcement Learning for Sports Analytics. Amount: $500K/3 years, success rate 20%. Our company partner is SportLogiq. My co-applicant is Pascal Poupart (Waterloo).
- NSERC Discovery and Accelerator award ($36K/year, $40K/year). One of 125 national awards. The Accelerator awards provide substantial and timely additional resources to maximize the impact of outstanding research programs.
- Blue Ribbon Service Award from the International Joint Conference on Artificial Intelligence (2016). IJCAI is the leading AI conference.

Refereed Research Papers (last five years)

Conference Papers (main archival publication mode in computer science)

AR = Acceptance Rate

C1. Inverse Reinforcement Learning for Team Sports: Valuing Actions and Players. Yudong Luo, Oliver Schulte, and Pascal Poupart (2020). Proceedings IJCAI. AR: 12%. In Press.
C2. Cracking the Black Box: Distilling Deep Sports Analytics. Xiangyu Sun, Jack Davis, Oliver Schulte, Guiliang Liu (2020). Proceedings ACM Knowledge Discovery and Data Mining (KDD). AR: 16%. In press.
C3. A Complete Characterization of Projectivity for Statistical Relational Models. Manfred Jaeger and Oliver Schulte (2020). Proceedings IJCAI. AR: 12%. In Press.
C4. Yan, J. N, Schulte, O., Zhang, M., Wang, J., & Cheng, R. "SCODED: Statistical Constraint Oriented Data Error Detection." Proceedings of the 2020 ACM SIGMOD International Conference on Management of Data, pp. pp. 845-860. AR: 27%
C5. Deep Generative Probabilistic Graph Neural Networks for Scene Graph Generation. Khademi M and Schulte O. (2020). Proceedings AAAI, pp. 11237-11245. AR 20.6%.
C6. Dynamic Gated Graph Neural Networks for Scene Graph Generation. Mahmoud Khademi and Oliver Schulte (2019). *Asian Conference on Computer Vision,* LNCS 11366, pp. 1–17.

Abbreviated C.V. – Oliver Schulte

C7. Toward Interpretable Deep Reinforcement Learning with Linear Model U-Trees (2018). Guiliang Liu, Oliver Schulte, Wang Zhu and Qingcan Li. *Proceedings European Conference on Machine Learning, ECML* pp. 414-429.
C8. G. Liu and O. Schulte (2018). Deep Reinforcement Learning in Ice Hockey for Context-Aware Action Values and Player Evaluation. Proceedings IJCAI, pp.3442-3448.
C9. O. Schulte and S. Gholami (2017). Locally Consistent Bayesian Network Scores for Multi-Relational Data. Proceedings IJCAI, pp.2693-2700.
C10. O. Schulte, Z. Zhao, M. Javan, and P. Desaulniers (2017). Apples-to-Apples: Clustering and Ranking NHL Players Using Location Information and Scoring Impact. MIT Sloan Sports Analytics Conference, Boston, MA, USA.
C11. F. Riahi and O. Schulte (2016). Propositionalization for Unsupervised Outlier Detection in Multi-Relational Data. FLAIRS-29. Proceedings International Florida Artificial Intelligence Research Society Conference, Key Largo, FL, USA, pp.448-453.
C12. F. Riahi and O. Schulte (2015). Model-Based Outlier Detection for Object-Relational Data. IEEE Symposium Series on Computational Intelligence, Cape Town, South Africa, pp.1590-1598. *Best Student Paper Award.*
C13. Z. Qian and O. Schulte (2015). FactorBase: Multi-relational model learning with SQL all the way. *Proceedings Data Science and Advanced Analytics (DSAA)*, pp. 1--10.
C14. K. Routley and O. Schulte (2015). A Markov Game Model for Valuing Player Actions in Ice Hockey. Proceedings Uncertainty in Artificial Intelligence (UAI 2015), pp.782-791.

Journal Papers

J1. Riahi, F. & Schulte, O. (2020), 'Model-based exception mining for object-relational data', *Data Mining and Knowedge. Discovery* **34**(3), 681--722.
J2. Schulte, O. & Qian, Z. (2018), 'FACTORBASE: multi-relational structure learning with SQL all the way', *International Journal of Data Science and Analytics* **7(4)**, 1--21.
J3. Schulte, O. (2018), 'Causal Learning with Occam's Razor', *Studia Logica* **107(5)**, 991--1023.
J4. O. Schulte, M. Khademi, S. Gholami, Z. Zhao, M. Javan, and P. Desaulniers, "A Markov Game Model for Valuing Actions, Locations, and Team Performance in Ice Hockey," Data Mining and Knowledge Discovery, vol.31, no.6, pp.1-23, 2017.
J5. D. Beaudoin, O. Schulte, and T.B. Swartz, "Biased Penalty Calls in the National Hockey League," Statistical Analysis and Data Mining: The ASA Data Science Journal, vol.9, no.5, pp.365-372, 2016.
J6. Schulte, O.; Qian, Z.; Kirkpatrick, A. E.; Yin, X. & Sun, Y. (2016), 'Fast learning of relational dependency networks', *Machine Learning*, 1--30.

Supervision (last 6 years, including active students)

- 6 M.Sc., 3 Ph.D. Students
- Kurt Routley received an award for the *best Canadian AI Master's Thesis* of 2015 from the Canadian Artificial Intelligence Association for his work on hockey analytics.

Service

- Co-organizer, Vancouver Hockey Analytics Conference, 2016 and 2018.
- Coordinator, Organizing Committee, Workshop on New Perspectives in Relational Learning. Banff International Research Station. 42 participants. May 2015.

STEVEN BERGNER https://stevenbergner.github.io/

Summary

- Strong research coordination and execution with numerous academic and industrial partners

Experience

Dept. of Computing Science, Simon Fraser University – Burnaby, BC

University Research Associate 09/2017 – present

- Research, teaching, and graduate student supervision

Teaching

- CMPT 732 & 733, *Big Data Programming 1 & 2* in Fall & Spring (respectively) 2017, 2019, 2020
- CMPT 767, *Visualization*, Fall 2018 – re-developed course content to combine Information Visualization (design and user interaction) with Scientific Visualization (numerical methods for multi-variate data and computer graphics); Final projects of high quality, leading to Conf. publication and MSc thesis (L. Sawatzky)

Thesis supervision

- Supervisor for MSc Lindsey Sawatzky "*Understanding RNN States with Predictive Semantic Encodings and Adaptive Representations*". Dept. of Computing Science, SFU, 2019 (passed "as is")
- Supervisor for MSc (in preparation) Volodymyr Kozyr "*Visual Analytics for Sustainable Fish Management*", Dept. of Computing Science, SFU, 2020 (tentative)
- Chapter topic contributor for MSc. Thesis of S. Nabi Abdolyousefi. "*Equilibria of a nonlocal model for biological aggregations: Linear stability and bifurcation studies.*" Dept. of Mathematics, SFU, 2011.

Grant authorship (selection)

- With Avcorp & D-Wave: manufacturing process optimization & digital twinning; $42k CAD component out of larger >$100k grant; Strategic value: **SFU's first Digital Supercluster grant**; grant writer, PI, supervisor
- **$1.03M DFO govt grant**, Co-PI, (PI Dr. Ruth Joy, SFU) "*Building Neural Networks for Classification of Killer Whale Calls*", collaboration with U Carleton, U Dalhousie, and Orca Sound, Apr 2020
- (bid in preparation) $900k CAD Canadian Space Agency, collaboration with R. Joy and industrial partner GSTS "Movement forecasting for North Atlantic Right Whales using satellite imagery", submit by Sep. 2020

Big Data Initiative, Simon Fraser University – Burnaby, BC

Lead Consultant and R&D Service team supervisor 10/2017 – present

- Business development for SFU Big Data Initiative, Technical project acquisition and delivery
- **Supervisor of up to 12 RA students per semester** (Computing Science, Statistics, and other departments) with large portion of students continuing for multiple semesters; overall >20 students supervised
- Acquisition and delivery of **>$200k CAD of client projects** (industrial, governmental, academic)

Clients (selection)

- *Coppertree* - Building HVAC control analysis; client via SFU Advancement, Mitacs grant of $30k CAD; Strategic value for SFU: subsequent projects and possible sponsored faculty position with SFU SEE, Surrey
- *Traction Creative*, **$92k CAD funded by** Govt of Canada – Dept. of **Fisheries and Oceans Canada**, fish species detection in photographic images via deep learning model running on cellphones (with SFU RCG)
- *SFU REM CEDAAC* - Economic environmental simulation model of country-wide fuel consumption and greenhouse gas emission; $70k CAD, re-write in Python, code contributor, technical supervisor (with RCG)

Workshops

- *ICBC* – Introduction to NLP (2018, 2 days), Apache Spark for Data Science teams (2020, 2 days) Strategic value: will be PI on further research collaboration of ICBC & SFU on text understanding (Aug 2020)
- *Fraser Health* - Big Data for Data Science with Intro to Python (2 days, 2020)
- *SFU* Data Fellowship (Summer 2020) – Curriculum and content development & delivery with Fred Popowich and Jillian Anderson (RCG); Our combination of Data Science with Intro to Python reaches broad audience

phone: 778-893-1335 **address:** 21 Mercier Rd, Port Moody BC, V3H 3J5 **email:** sbergner@sfu.ca

STEVEN BERGNER https://stevenbergner.github.io/

Dept. of Statistics and Actuarial Sciences, Simon Fraser University – Burnaby, BC

Research Associate 12/2016 – 08/2017
Postdoctoral Fellow 01/2012 – 05/2013

- Design and analysis of computer experiments using GP models for large-scale cosmological simulation
- Speaker at Vancouver Data Science/Kaggle meetup; TA for machine learning course CMPT 726

FinancialCAD Corporation – Surrey, BC

Quantitative Analyst 04/2014 – 11/2016
Quantitative Developer 06/2013 – 03/2014

- Research, design, and implementation of flagship analytics features in the main FINCAD product
- Technologies: **C++ (Boost), Python, XML, SVN, Mathematica, JIRA**

Education

Simon Fraser University – Burnaby, BC

PhD, Computing Science 12/2011

- Thesis: *Making choices in multi-dimensional parameter spaces*. Advanced computational modeling and data analysis workflows through novel approaches to parameter sampling and visualization; passed "as is", GPA 4.0
- Publications in top journals and conferences in data visualization and computer graphics
- Designed software framework to share code for visualization of spatial data using **C++, OpenGL, XML**

Otto-von-Guericke University – Magdeburg, Germany

M.Sc., Computational Visualistics (Dipl.-Ing., MEng. level degree) 09/1998 – 12/2003

- Thesis: *Structural deformable models for robust object recognition.* Using local shape features and structural knowledge of body parts to classify ant species in a database of macro photographic images
- Lifetime Member of the German Merit Foundation, awarded to top 0.5% of university students
- Best Graduate of 2003/2004 class

Publications (selection)

Grants and theses not included (see Experience and Education above)

Bergner, S., Bingham, D., Van De Ville, D., Blu, T., & Möller, T. (*in prep for J. submission*). Sampling lattices with rotational similarity for experimental design.
Sawatzky, L., **Bergner, S.**, & Popowich, F. (2019). Visualizing RNN States with Predictive Semantic Encodings. *2019 IEEE Vis. Conf. (VIS)*, (pp. 156–160).
Torsney-Weir, T., **Bergner, S.**, Bingham, D., & Möller, T. (2016). Predicting the interactive rendering time threshold of Gaussian process models with HyperSlice. *IEEE Trans. on vis. and computer graphics, 23*, 1111–1123.
Heitmann, K., Bingham, D., Lawrence, E., **Bergner, S.**, Habib, S., Higdon, D. (2016). The Mira–Titan universe: precision predictions for dark energy surveys. *The Astrophysical Journal, 820*, 108.
Bergner, S., Sedlmair, M., Möller, T., Abdolyousefi, S. N., & Saad, A. (2013). Paraglide: Interactive parameter space partitioning for computer simulations. *IEEE Transactions on Visualization and Computer Graphics, 19*, 1499–1512.
Torsney-Weir, T., Saad, A., Moller, T., Hege, H.-C., Weber, B., Verbavatz, J.-M., & **Bergner, S.** (2011). Tuner: Principled parameter finding for image segmentation algorithms using visual response surface exploration. *IEEE Trans. on Visualization and Computer Graphics, 17*, 1892–1901.
Ingram, S., Munzner, T., Irvine, V., Tory, M., **Bergner, S.**, & Möller, T. (2010). Dimstiller: Workflows for dimensional analysis and reduction. *2010 IEEE Symposium on Visual Analytics Science and Technology*, (pp. 3–10).
Bergner, S., Drew, M. S., & Möller, T. (2009). A tool to create illuminant and reflectance spectra for light-driven graphics and visualization. *ACM Transactions on Graphics (TOG), 28*, 1–11. (presented at **ACM SIGGRAPH** 2009)
Drew, M. S., & **Bergner, S.** (2008). Spatio-chromatic decorrelation for color image compression. *Signal Processing: Image Communication, 23*, 599–609.
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KangKang Yin

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1-7789186668 kkyin@sfu.ca http://www.cs.sfu.ca /~kkyin

Short Bio

KangKang Yin is currently an Associate Professor in the School of Computing Science at the Simon Fraser University. From 2010 to 2016 she was a faculty member in the Department of Computer Science at the National University of Singapore. She worked as an Associate Researcher at Microsoft Research Asia from 2008 to 2010, after she obtained her PhD degree from the University of British Columbia in 2007. Her research interests include Computer Animation and Geometry Processing, Computer Vision, Machine Learning, Human Computer Interaction, and Humanoid Robotics. She regularly serves on the program committees of all major computer graphics conferences including SIGGRAPH, SIGGRAPH Asia, Eurographics, SCA (ACM SIGGRAPH / Eurographics Symposium on Computer Animation), among others. She is currently an Associate Editor of Computer Graphics Forum. She was a program co-chair for Pacific Graphics 2013 and SCA2017. She has won three SCA best-paper awards (2011, 2013 and 2015). She is a senior member of ACM and IEEE.

Recent Grants (since joined SFU in 2017)

- Alibaba: Open Cloud Robots Platform for Grasping and Manipulation, 04/2021-03/2022, CAD $381,250
- Alibaba: Visual SLAM by Convolutional Neural Networks, 07/2020-06/2021, CAD $140,000
- Huawei-SFU Visual Computing Joint Lab: Deep Analysis of Human Motion, 03/2019-03/2020, CAD $88,000
- NSERC Discovery: Advanced Modeling of Human Movement for Computer Animation, 04/2018-03/2023, CAD $170,000
- NSERC Discovery Accelerator: Advanced Modeling of Human Movement for Computer Animation, 04/2018-03/2021, CAD $120,000

Recent Publications (since joined SFU in 2017)

Refereed Journal Papers

1. Zhiqi Yin, Zeshi Yang, Michiel van de Panne, KangKang Yin. Discovering Diverse Athletic Jumping Strategies. ACM Transactions on Graphics, 40, 4 , Article 91 (Proc. ACM SIGGRAPH 2021), 17 pages.
2. Li-Ke Ma, Zeshi Yang, Xin Tong, Baining Guo, KangKang Yin. Learning and Exploring Motor Skills with Spacetime Bounds. Computer Graphics Forum, 40, 2 (Proc. Eurographics 2021).
3. Zhiqi Yin and KangKang Yin. Linear Time Stable PD Controllers for Physics-based Character Animation. Computer Graphics Forum, 39, 8 (Proc. ACM SIGGRAPH/Eurographics Symposium on Computer Animation 2019).
4. Li-Ke Ma, Zeshi Yang, Baining Guo, KangKang Yin. Towards Robust Direction Invariance in Character Animation. Computer Graphics Forum, Volume 38, Issue 7, pp. 235-242.
5. Hongxing Qin, Yi Chen, Yunhai Wang, Xiaoyang Hong, KangKang Yin, Hui Huang. Laplace-Beltrami Operator on Point Clouds Based on Anisotropic Voronoi Diagram. Computer Graphics Forum, 37, 6, 2018, pp. 106-117.
6. Xue Bin Peng, Glen Berseth, KangKang Yin, Michiel van de Panne. DeepLoco: Dynamic Locomotion Skills Using Hierarchical Deep Reinforcement Learning. ACM Transactions on Graphics, 36, 4, Article 41 (Proc. ACM SIGGRAPH 2017), 16 pages.

Refereed Conference Papers

7. Mahdi Davoodikakhki and KangKang Yin. Hierarchical Action Classification with Network Pruning. 15th International Symposium on Visual Computing (ISVC 2020).
8. Andreas Aristidou, Qiong Zeng, Efstathios Stavrakis, KangKang Yin, Daniel Cohen-Or, Yiorgos Chrysanthou, Baoquan Chen. Emotion Control of Unstructured Dance Movements. ACM SIGGRAPH/Eurographics Symposium on Computer Animation 2017, Article 9.

Book Chapters

9. KangKang Yin, Libin Liu, Michiel van de Panne. Simulation for Control. In Humanoid Robotics: A Reference. Prahlad Vadakkepat, Ambarish Goswami, Jong-Hwan Kim (Editors-in-Chief). Springer 2018.
10. KangKang Yin, Stelian Coros, Michiel van de Panne. Biped Controller for Character Animation. In Handbook of Human Motion. Bertram Müller and Sebastian I. Wolf (Editors-in-Chief). Springer 2018.

Supervisions (since joined SFU in 2017)

PhD: Zeshi Yang; Li-ke Ma (Co-supervision); Mohammad Mahdavian (Co-supervision)

MSc: Zhiqi Yin; Mahdi Davoodikakhki; Adam Badke (Co-supervision)

Appendix 6 Budget for the proposed program (financial and personnel)

Program Cost

A. Instructional costs

Most faculty members teaching courses for the visual computing program will also teach courses for other programs so the cost has been included proportionally.

Course instructors are generally supported by Teaching Assistants.

B. Staffing

The new program, together with other master's programs, will be supported by dedicated administrative staff and the program director. Cost for administration will be shared between programs.

C. Equipment and lab

IT support and technical equipment is also shared with the other master's programs.

The professional visual computing program will share a lab (currently located at Blusson Hall) with the professional computer science program. Another lab is currently used exclusively for the latter because of the larger cohort size in that program. The school is hoping to also run a new professional cybersecurity program in the future and, if approved, will require an additional lab (so in total there will be 3 labs). The new lab will be shared between three programs (professional computer science, professional visual computing and professional cybersecurity) that the School aims to offer concurrently, so 1/3 of the set-up cost of the new lab has been included in this budget.

D. Other expenses

Expenses for recruitment, marketing and retention have been included in the budget.

Proposed tuition and other program fees including a justification

The tuition fee structure is based on a per term (not per unit) fee of $9,000 (CAD) per term for domestic students and $12,500 (CAD) for international students. Please note that the same per-term fee applies to the industrial internship term as well. We expect most students to graduate in four terms, but, in cases where additional terms are required for program completion, a continuing fee is assessed for each additional term. The continuing fee is half the normal tuition per term.

Total tuition cost for domestic students (4 terms): $36,000 (CAD)

Total tuition cost for international students (4 terms): $50,000 (CAD)

	TOTAL	Term 1	Term 2	Term 3	Annual fee (3 terms)
Domestic	$36,000	$9,000	$9,000	$9,000	$27,000
International	$50,000	$12,500	$12,500	$12,500	$37,500

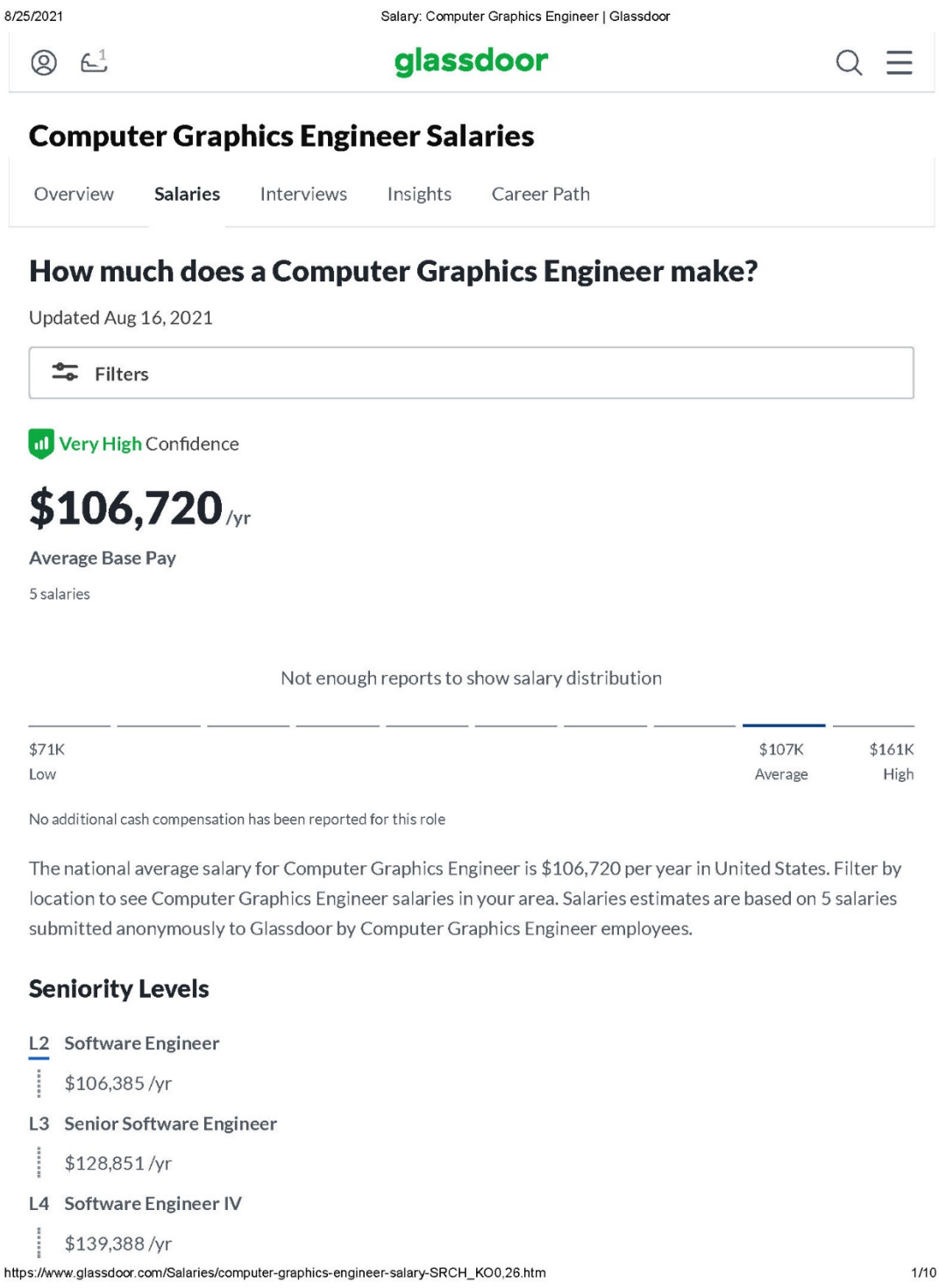
1. **Revenue**

The revenue is based on 3 terms (annual revenue), for enrolment numbers see enrolment plan.

Enrollment revenue	**Year 1**	**Year 2**	**Year 3**
Domestic	$472,500.00	$659,137.50	$672,320.25
International	$656,250.00	$924,309.29	$964,643,75
TOTAL	**$1,128,750.00**	**$1,583,446.79**	**$1,636.964.00**

2. Overall budget

	Year 1	Year 2	Year 3
Program Expenses	$ 614,830.00	$ 626,300.00	$ 553,488.00
Program Revenue	$ 1,128,750.00	$ 1,583,446.79	$ 1,636,964.00
Net Income	$513,920.00	$1,042,196.79	$1,202,120.75



8/25/2021 Salary: Computer Graphics Engineer | Glassdoor

glassdoor

Computer Graphics Engineer Salaries

Overview **Salaries** Interviews Insights Career Path

How much does a Computer Graphics Engineer make?

Updated Aug 16, 2021

Filters

Very High Confidence

$106,720 /yr

Average Base Pay

5 salaries

Not enough reports to show salary distribution

$71K	$107K	$161K
Low	Average	High

No additional cash compensation has been reported for this role

The national average salary for Computer Graphics Engineer is $106,720 per year in United States. Filter by location to see Computer Graphics Engineer salaries in your area. Salaries estimates are based on 5 salaries submitted anonymously to Glassdoor by Computer Graphics Engineer employees.

Seniority Levels

L2 Software Engineer

$106,385 /yr

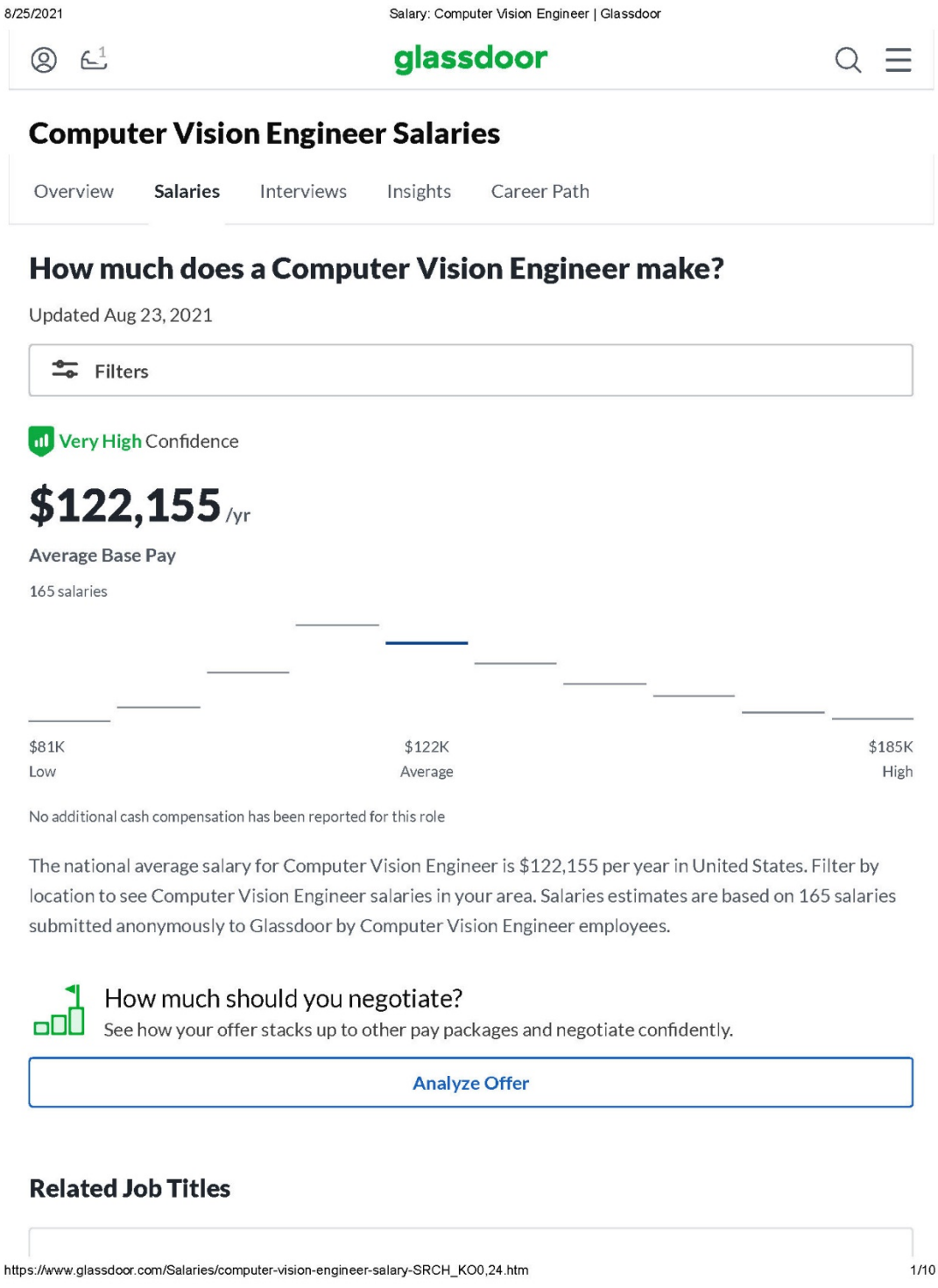
L3 Senior Software Engineer

$128,851 /yr

L4 Software Engineer IV

$139,388 /yr

https://www.glassdoor.com/Salaries/computer-graphics-engineer-salary-SRCH_KO0,26.htm 1/10



8/25/2021 Salary: Computer Vision Engineer | Glassdoor

glassdoor

Computer Vision Engineer Salaries

Overview **Salaries** Interviews Insights Career Path

How much does a Computer Vision Engineer make?

Updated Aug 23, 2021

Filters

Very High Confidence

$122,155 /yr

Average Base Pay

165 salaries

$81K	$122K	$185K
Low	Average	High

No additional cash compensation has been reported for this role

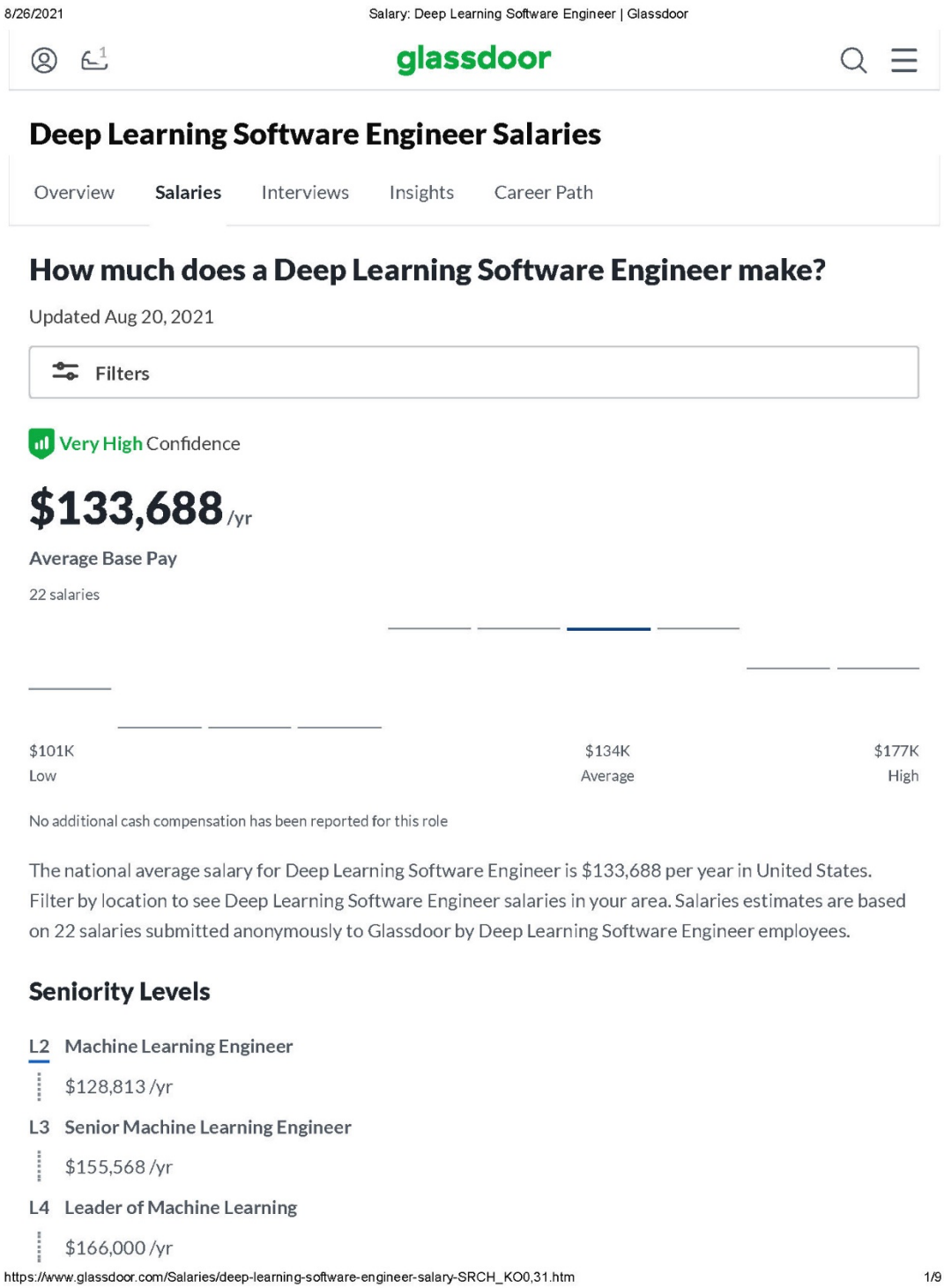
The national average salary for Computer Vision Engineer is $122,155 per year in United States. Filter by location to see Computer Vision Engineer salaries in your area. Salaries estimates are based on 165 salaries submitted anonymously to Glassdoor by Computer Vision Engineer employees.

How much should you negotiate?
See how your offer stacks up to other pay packages and negotiate confidently.

Analyze Offer

Related Job Titles

https://www.glassdoor.com/Salaries/computer-vision-engineer-salary-SRCH_KO0,24.htm 1/10



8/26/2021 Salary: Deep Learning Software Engineer | Glassdoor

glassdoor

Deep Learning Software Engineer Salaries

Overview **Salaries** Interviews Insights Career Path

How much does a Deep Learning Software Engineer make?

Updated Aug 20, 2021

Filters

Very High Confidence

$133,688 /yr

Average Base Pay

22 salaries

$101K	$134K	$177K
Low	Average	High

No additional cash compensation has been reported for this role

The national average salary for Deep Learning Software Engineer is $133,688 per year in United States. Filter by location to see Deep Learning Software Engineer salaries in your area. Salaries estimates are based on 22 salaries submitted anonymously to Glassdoor by Deep Learning Software Engineer employees.

Seniority Levels

L2 Machine Learning Engineer

$128,813 /yr

L3 Senior Machine Learning Engineer

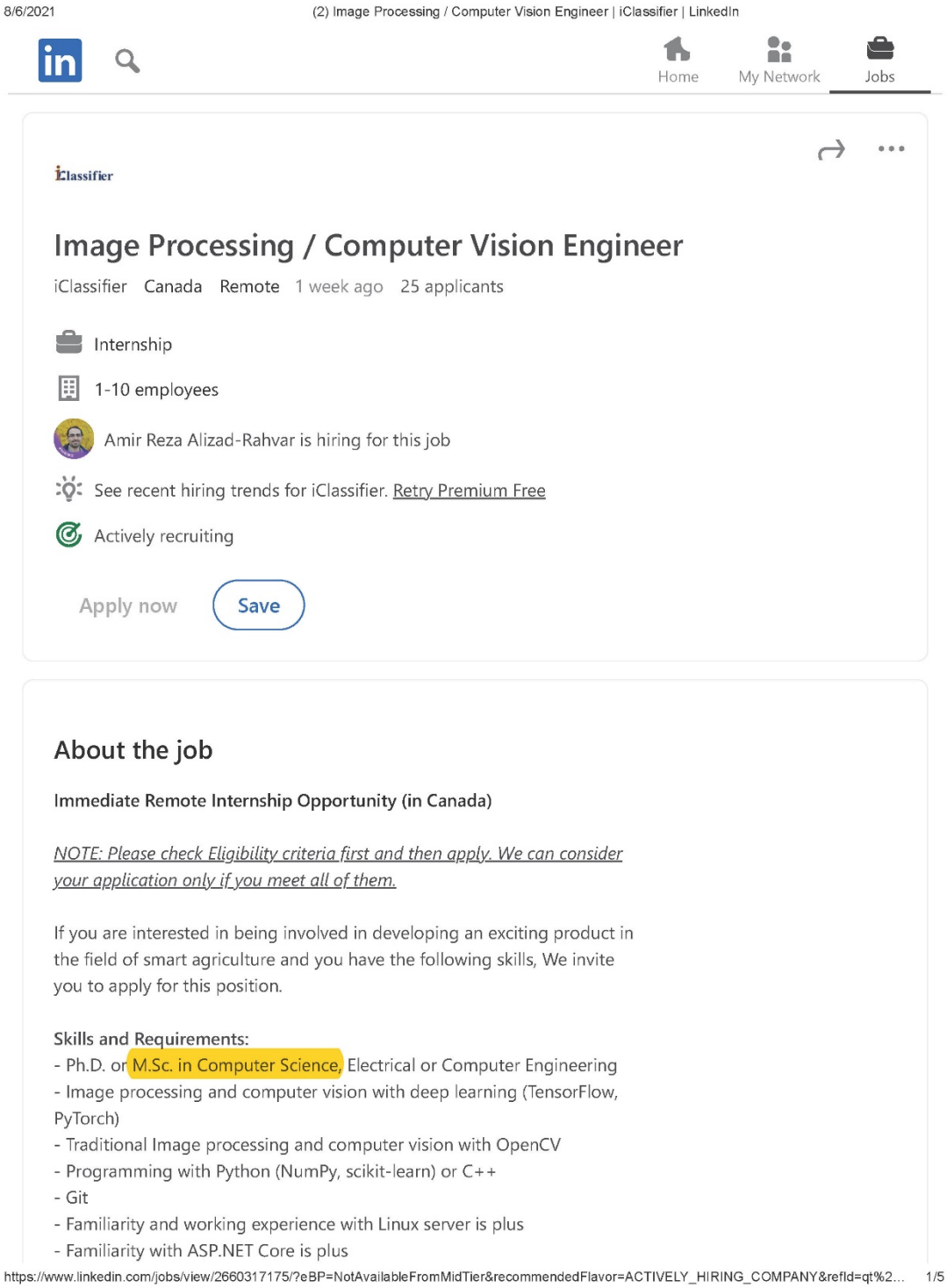
$155,568 /yr

L4 Leader of Machine Learning

$166,000 /yr

https://www.glassdoor.com/Salaries/deep-learning-software-engineer-salary-SRCH_KO0,31.htm 1/9

Appendix 9 Examples of Job postings



8/6/2021 (2) Image Processing / Computer Vision Engineer | iClassifier | LinkedIn

Home My Network Jobs

iClassifier

Image Processing / Computer Vision Engineer

iClassifier Canada Remote 1 week ago 25 applicants

Internship

1-10 employees

Amir Reza Alizad-Rahvar is hiring for this job

See recent hiring trends for iClassifier. Retry Premium Free

Actively recruiting

Apply now Save

About the job

Immediate Remote Internship Opportunity (in Canada)

NOTE: Please check Eligibility criteria first and then apply. We can consider your application only if you meet all of them.

If you are interested in being involved in developing an exciting product in the field of smart agriculture and you have the following skills, We invite you to apply for this position.

Skills and Requirements:
- Ph.D. or M.Sc. in Computer Science, Electrical or Computer Engineering
- Image processing and computer vision with deep learning (TensorFlow, PyTorch)
- Traditional Image processing and computer vision with OpenCV
- Programming with Python (NumPy, scikit-learn) or C++
- Git
- Familiarity and working experience with Linux server is plus
- Familiarity with ASP.NET Core is plus

https://www.linkedin.com/jobs/view/2660317175/?eBP=NotAvailableFromMidTier&recommendedFlavor=ACTIVELY_HIRING_COMPANY&refId=qt%2... 1/5

Responsibilities:
- Working, communicating, and collaborating with a cross-functional team of engineers and animal scientists
- Data collection (taking photos in farms)
- Data pre-processing and data labeling for model training
- Developing image processing tools by using deep learning and OpenCV
- Integrating the developed tools with previously developed products (e.g., mobile and web applications)

Eligibility:
Candidate must meet "Youth Employment in NRC IRAP program" eligibility criteria:
- Younger than 30 years old at the start of the internship
- a post-secondary graduate
- a Canadian citizen, permanent resident of Canada or person granted refugee status in Canada
- legally entitled to work according to the relevant provincial legislation and regulations
- a first-time participant in a Youth Employment and Skills Strategy work experience program targeted at post-secondary graduates

- This position requires a minimum commitment of 30 hours per we ek. The work is Remote (Canada-wide), and the schedule is flexible with hours to be agreed on before the internsh ip begins.
- The term of the internship is 7 months **(Sep. 2021-March 2022)**.

Pay range: $4000.00 - $4300.00 per month

See less

Pay range unavailable

Salary information is not available at the moment.

Jumio Corporation Careers

Machine Learning Engineer

Apply

Description

Jumio is the future for online and mobile ID Verification. We are the largest and fastest growing company in the end-to-end identity verification space. With a global footprint, we have clients across a range of industries including Travel, Sharing Economy, Fintech, Gaming, and others. Headquartered in Silicon Valley, California, and with offices around the globe, Jumio has been the recipient of numerous awards for innovation from leading industry associations.

As ML Engineer at Jumio, you will be embedded in an international and diverse team of passionate professionals with a strong engineering culture and established Agile practice. You will work on challenges at the intersection of computer vision and knowledge extraction.

Some examples of your daily responsibilities:

- Develop machine learning algorithms to structure information
- Perform research to implement advanced algorithms
- Craft production-grade code
- Keep apace with developments in your field of activity (deep learning, NLP, computer vision, knowledge extraction) by reading papers or attending conferences
- Collaborate with other engineers and product managers in an Agile environment

Qualifications

- Minimum MSc with 3+ years of relevant experience
- Hands-on experience with either Pytorch or Tensorflow and crafting production-grade Python code
- Fluency in natural language processing (tokenization, word embeddings, language models)
- Experience in implementing best practices for monitoring and maintaining ML models in a production environment
- Previously built, trained and shipped models on cloud services
- Proven communication and problem-solving skills

Nice to have

- Experience with transformer models

How do you and your team make a difference?

You will be part of a small and focused team responsible for designing and building a new capability in Jumio portfolio of AI-powered verification solutions. This is an opportunity to challenge yourself and make a big impact by bringing to the market a new offering characterized by the same speed, high reliability and high precision as all Jumio products.

We offer an annual full time salary (38,5hr week) of minimum 50.000€ gross with a possible overpayment depending on qualifications and experience, plus we offer a great range of benefits for all employees.

servicenow

Staff Research Developer - ATG

6650 St. Urbain Street Suite 500, Montreal, Quebec, Canada
Employees can work remotely
Full-time
Region: AMS - North America and Canada
Employee Type: Regular

Company Description

ServiceNow is making the world of work, work better for people. Our cloud-based platform and solutions deliver digital workflows that create great experiences and unlock productivity for employees and the enterprise. We're growing fast, innovating faster, and making an impact on our customers' and employees' lives in significant and important ways. With over 6,900 customers, we serve approximately 80% of the Fortune 500, and we're on the 2020 list of FORTUNE World's Most Admired Companies.®

We're looking for people who are ready to jump right in and help us build on our incredible momentum, our diverse, engaged workforce, and our purpose to make the world of work, work better.

Learn more on Life at Now blog and hear from our employees about their experiences working at ServiceNow.

Job Description

The Advanced Technology Group (ATG) at ServiceNow is a customer-focused innovation group building intelligent software and smart user experiences using existing and latest advanced technologies to enable end-to-end, industry-leading work experiences for customers. We are a group of researchers, applied scientists, engineers, and product managers with a dual mission. We build and evolve the AI platform, and partner with teams to build products and end-to-end AI-powered work experiences. In equal measure, we lay the foundations, research, experiment, and de-risk AI technologies that unlock new work experiences in the future.

Le Groupe de technologie avancée (GTA) de ServiceNow est un groupe d'innovation axé sur le client qui crée des logiciels intelligents et des expériences utilisateurs intelligentes en utilisant les technologies de pointe existantes et les plus récentes pour offrir aux clients des expériences de travail de bout en bout à la pointe de l'industrie. Nous sommes un groupe de chercheurs, de scientifiques appliqués, d'ingénieurs et de chefs de produits avec une double mission. Nous construisons et faisons évoluer la plate-forme d'intelligence artificielle (IA), et nous nous associons à des équipes pour créer des produits et des expériences de travail de bout en bout basées sur l'IA. Dans la même mesure, nous posons les fondations, recherchons, expérimentons et réduisons les risques en matière de technologies d'IA qui ouvrent la voie à de nouvelles expériences de travail à l'avenir.

What you get to do in this role:

Work in ServiceNow's Machine Learning team and find new and innovative ways to solve hard problems in Natural Language Processing, by leveraging core machine learning, deep learning and AI techniques. Play a leading role in building the team's scientific expertise in that field. Opportunity to learn, work and contribute to the innovative and enterprise grade ServiceNow's Natural Language Understanding and Artificial Intelligence engine as part of the overall offering.

Specifically, you will:

- Design the natural language processing components of ServiceNow NLU capabilities by enhancing core deep learning algorithms.
- Work with team to generalize, scale and integrate these solutions at the platform level making it available as a core feature/functionality to all ServiceNow client base.
- Support, iterate and improve existing NLU capabilities to a desired level over a definitive time period.
- Participate in data collection, creating benchmarks, etc.
- Develop innovative patentable ideas that ensures the competitiveness of this product within the domain of similar work being done in the industry.
- Collaborate with the Research group to formulate research questions aligned with current and future product needs, actively working with them on knowledge and technology transfer towards platform and products.
- Advance the natural language capabilities of the ServiceNow platform.
- Bring intelligence to customer workflows by leveraging their individual data
- Structured data (workflow state evolution, database tables)
- Unstructured data (utterances, descriptions, documents)
- Adapting to their unique and complex workflows
- At Scale: 7000+ customers with a wide range of data volumes

Qualifications

To be successful in this role you have:

- A minimum of 8 years experience and a Master's degree, or a PhD with 6 years' experience.
- Solid Machine learning/Deep learning theoretical knowledge and practical experience.
- Excellent working knowledge of Python and its data science ecosystem (jupyter, pandas, etc.) as well as deep-learning frameworks (TensorFlow, PyTorch).
- Extensive working experience in Natural Language Processing (NLP)/Natural Language Understanding (NLU) based solutions.
- Extensive experience in leveraging dense distributional representations ("embeddings") in various problems and contexts.
- Exposure to scaling natural language models in multilingual environments.
- Solid practical experience to systematically approach, design and build a machine learning/deep learning solution, evaluate it and optimize it for production.
- Very good understanding of Transformer-based neural architecture and their applications for language tasks.
- Excellent knowledge in algorithms and data structures.
- Excellent problem-solving and critical thinking abilities, with a desire to build a deep and solid understanding of the problems faced and the solutions developed.
- Strong written and verbal communication skills with an ability and interest to mentor more junior colleagues.
- Working experience within product development teams is a must.
- Must have demonstrated capabilities to create innovative solutions as well as novel, patentable ideas.

Additional Information

ServiceNow is an Equal Employment Opportunity Employer. All qualified applicants will receive consideration for employment without regard to race, color, creed, religion, sex, sexual orientation, national origin or nationality, ancestry, age, disability, gender identity or expression, marital status, veteran status or any other category protected by law.

If you are an individual with a disability and require a reasonable accommodation to complete any part of the application process, or are limited in the ability or unable to access or use this online application process and need an alternative method for applying, you may contact us at +1 (408) 501-8550, or talent.acquisition@servicenow.com for assistance.

For positions requiring access to technical data subject to export control regulations, including Export Administration Regulations (EAR), ServiceNow may have to obtain export licensing approval from the U.S. Government for certain individuals. All employment is contingent upon ServiceNow obtaining any export license or other approval that may be required by the U.S. Government.

Posted by
Steve Taylor