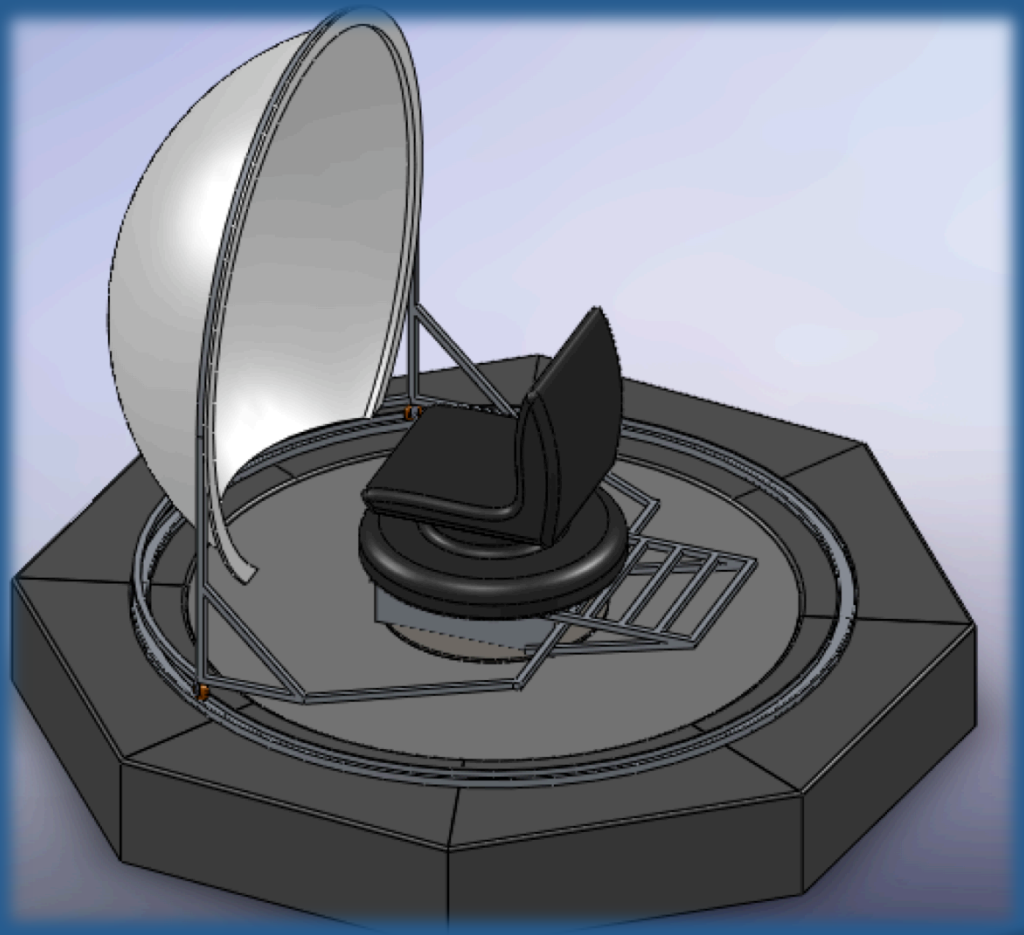
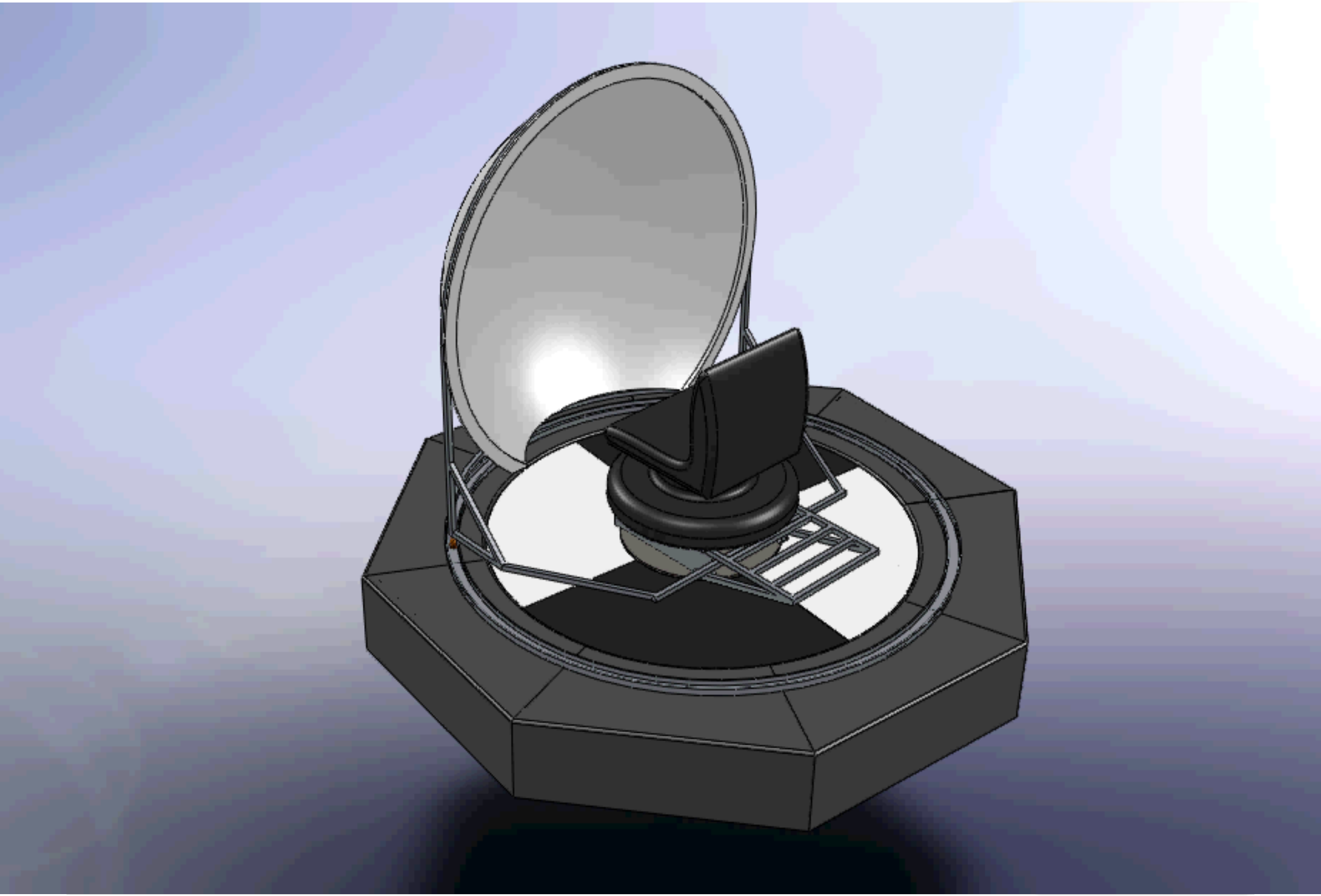
ISPACEMECHA

MSE – SIAT Collaboration

- Interactive Arts & Technology
  - *Thinking of Innovative Ideas for applications of Technology*
- Mechatronic Systems Engineering
  - *Providing the Engineering Skills required for creating these High-Tech Systems*

Multi-Modal Rotational Virtual Reality Laboratory Infrastructure





iSpace lab (Bernhard Riecke, ber1[at]sfu.ca)

immersive Spatial perception action/art cognition embodiment

Research philosophy: Human-centered, perceptually- and behaviorally-oriented approach

Fundamental research perspective Goal: Understand human system: Multi-modal perception/interaction with real/virtual env.
➔ what constitutes natural (effective, robust, & intuitive) human spatial orientation & behavior?

inspires, motivates, enables

Applied perspective Goal: Empower humans to effectively & intuitively interact with computers/computer-generated environments
➔ design human-computer interfaces that enable similar processes in VR

Methodology: Perceptual/ behavioral experiments in naturalistic, multi-modal VR
Approach: human in ecologically valid context whenever possible

Fulfill vision of Virtual Reality:
Computer-generated world accepted as alternate „Reality“
→ as compelling, immersive & empowering as real world

Theory:
unifying framework
→ deeper understanding, predictions, hypothesis-testing

VR as Enabling Technology:
Multi-modal, naturalistic & immersive VR provides the unique opportunity to study human perception & behavior in reproducible, clearly defined & controllable experimental conditions in a closed action-perception loop

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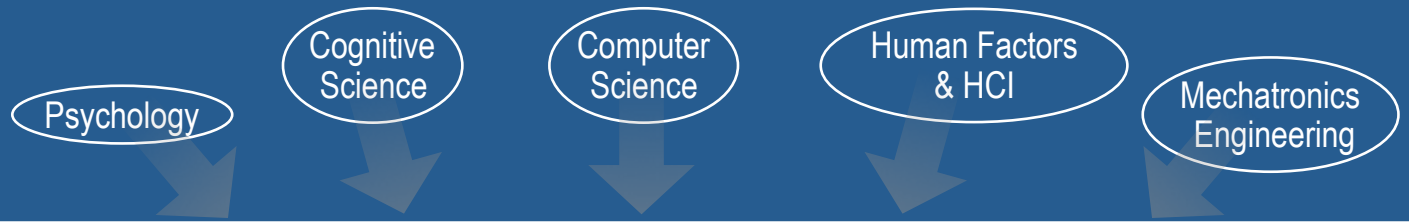

Long-term vision: Understanding & enabling effective spatial perception and behaviour in VR,
and use this knowledge to design novel, more effective human-computer interfaces/interaction paradigms

Fundamental research perspective
Understand human multi-modal perception/interaction with real/virtual env.: what constitutes natural, robust, intuitive, & embodied human perception & behavior?

inspires, motivates, enables

Applied perspective
Empower humans to effectively & intuitively interact with computers/computer-generated environments

Exploit multi-modal self-motion illusions

Leverage spatial updating

minimize reference frame conflicts

VR as Enabling Technology:
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immersive Spatial perception action/art cognition embodiment

Long-term vision & research plan

Long-term vision: Enabling effective spatial perception and behaviour in VR

- Investigate if/how vection facilitates mental perspective switches and/or spatial orientation/updating in VR
- Investigate and optimize multi-modal and higher-level contributions; minimize reference frame conflicts
- Use this knowledge to design novel, more effective human-computer interfaces/interaction paradigms

Short/mid-term vision & research plan

Exploit multi-modal self-motion illusions

(1) Self-motion illusions (vection)

Goal/Approach: Investigate and optimize

- multi-modal contributions and interactions
- higher-level (attentional/cognitive) contributions and interactions
- VR setups and interaction paradigms

Leverage spatial updating

(2) Spatial orientation/updating

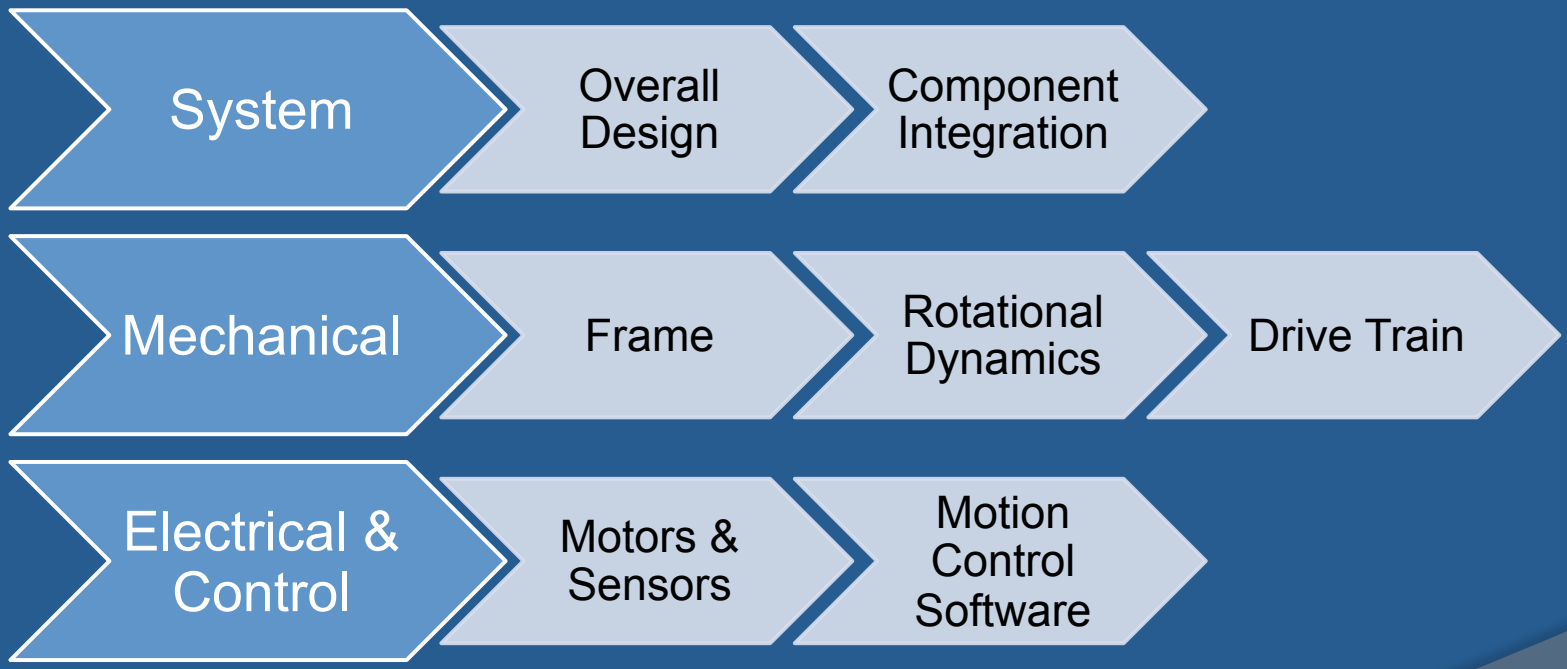
- Under what situations are visual cues sufficient to enable automatic/obligatory spatial updating?
- How can we leverage spatial updating by using multi-modal contributions and interactions?

minimize reference frame conflicts

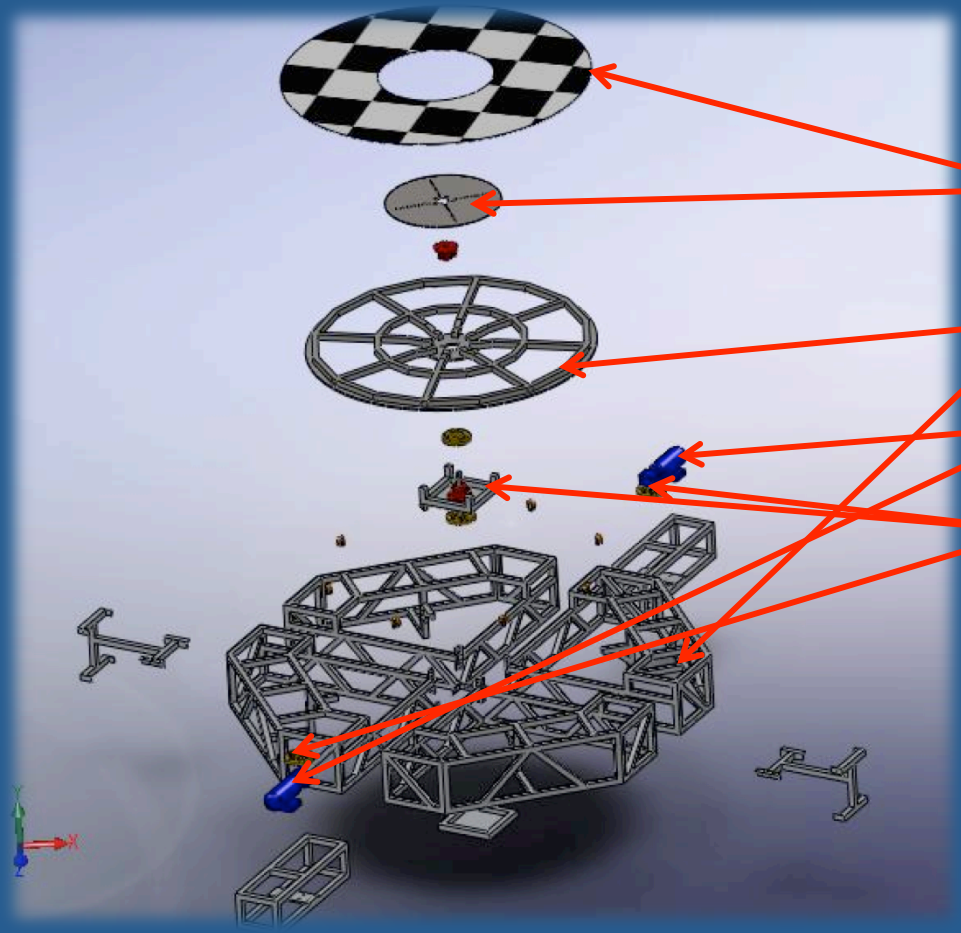
(3) Reference Frame Conflicts

- Investigate factors causing RFC in VR
- Optimize VR setups and interaction paradigms to minimize RFC in VR, to
- Enhance presence/immersion and enable natural & effective behaviour

Mechatronic Engineering



Systems Engineering



Rotating Rings

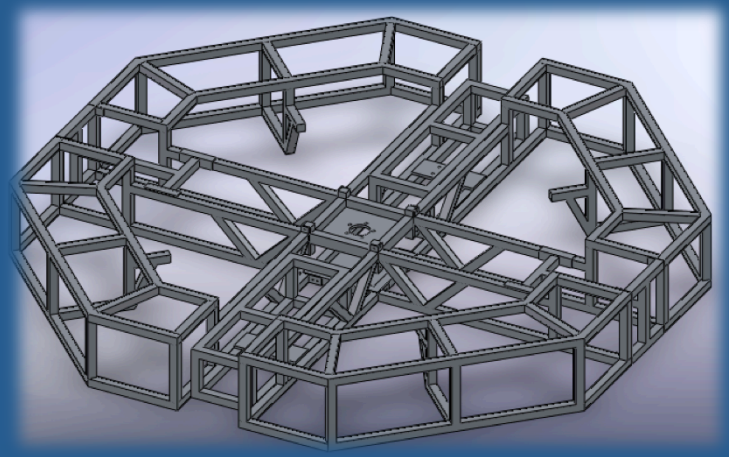
Frame & Supports

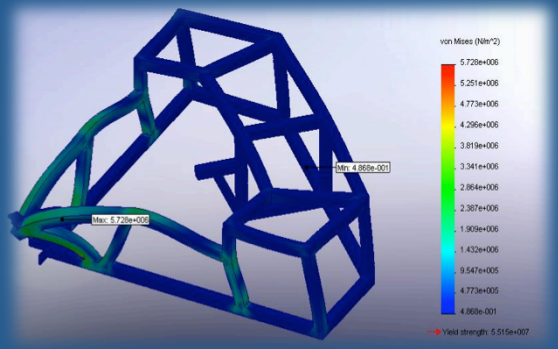
Motors

Drive Train

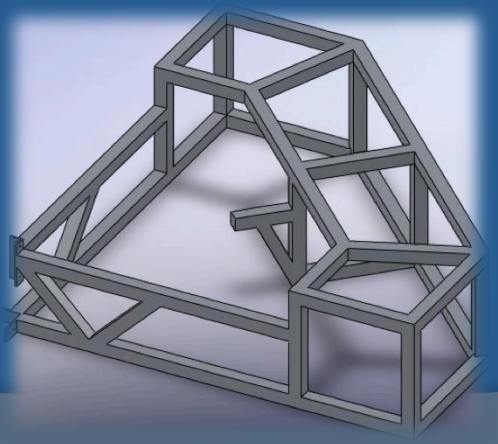
Mechanical Engineering

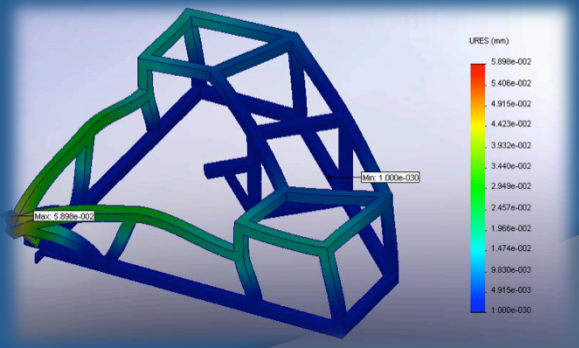
- Frame Design and Analysis





Stress Analysis

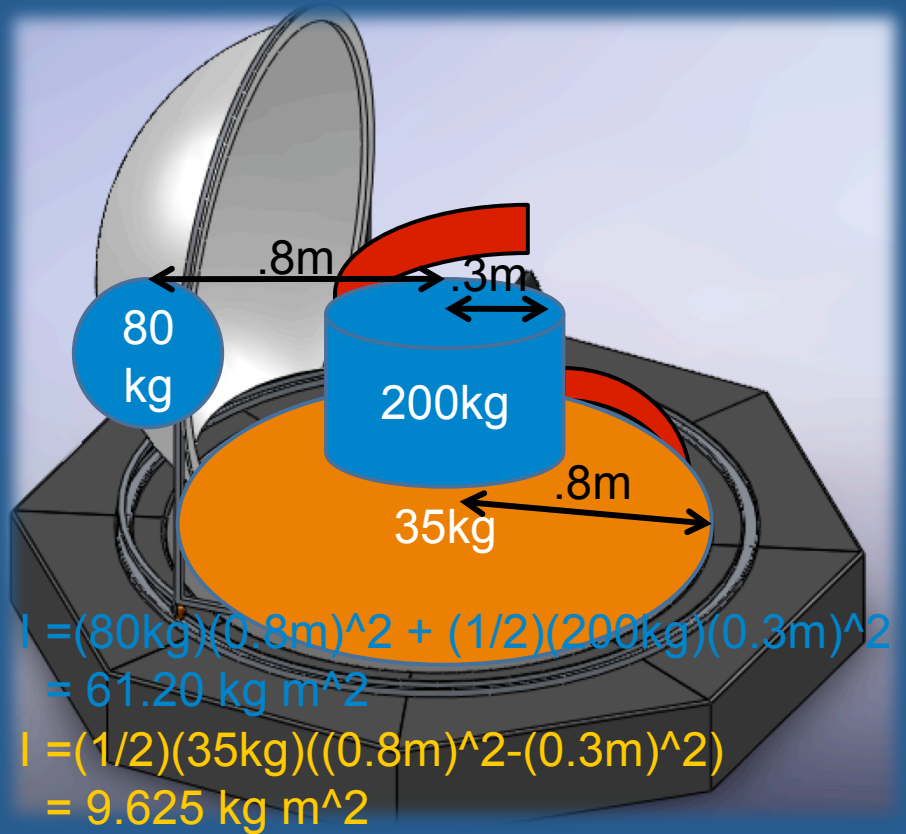




Displacement Analysis

Mechanical Engineering

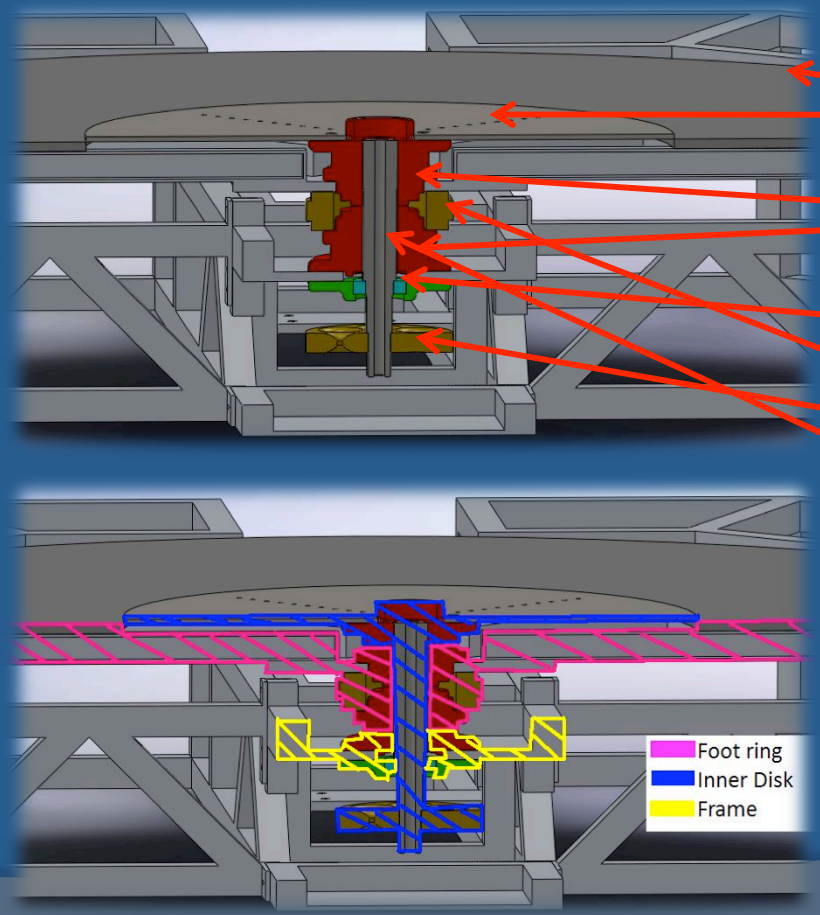
- Rotational Dynamics



- Independently rotating floor and chair with screen
- Designed to smoothly and accurately maneuver a rotating load

Mechanical Engineering

- Drive Train



Inner Disk & Foot Ring

Double Flanged Bearings

Ball Bearing

Synchronous Belt Sheaves

Drive Shaft

Electrical & Control

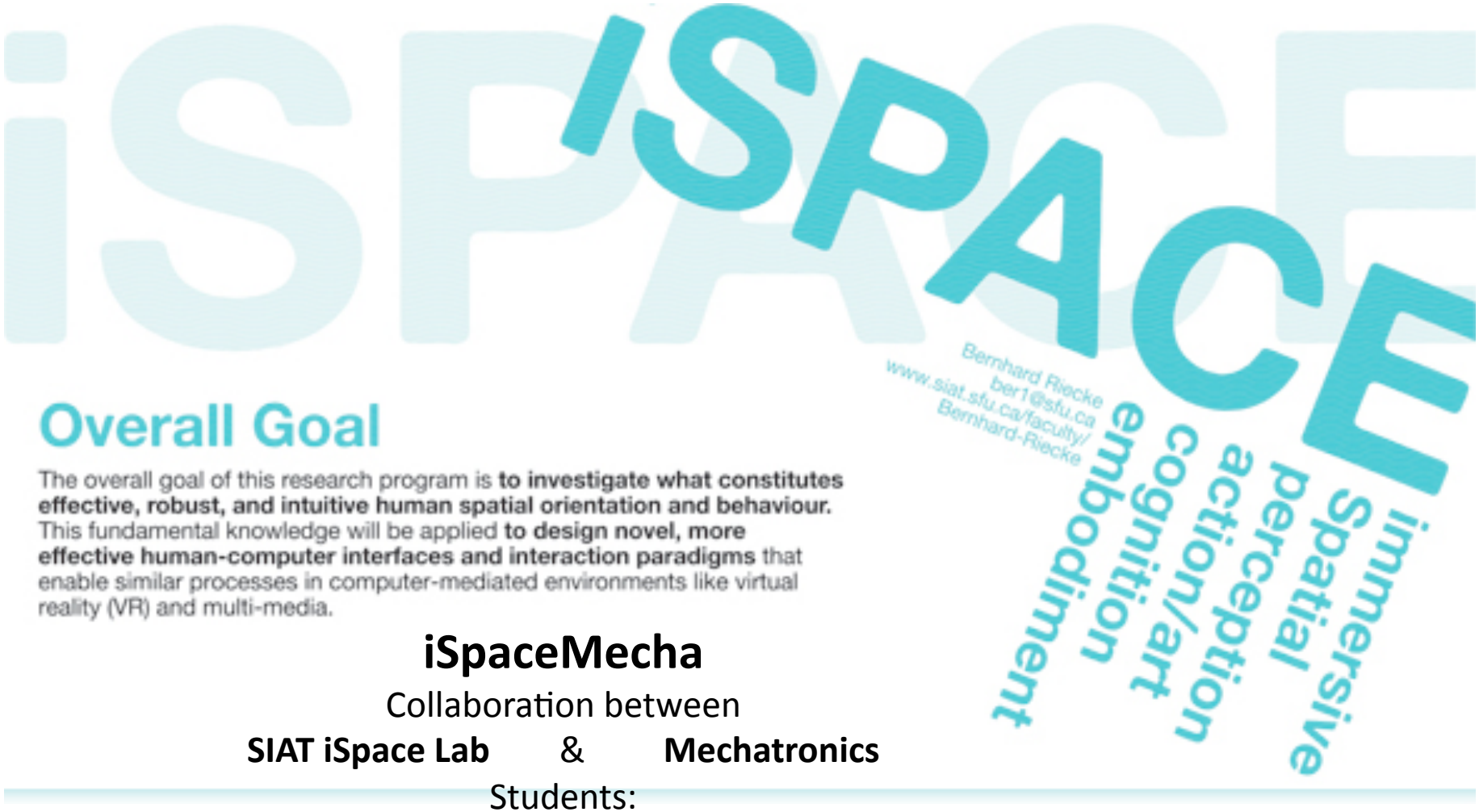
- Motors & Sensors

- DC Servo Motors
  - Controls:
    - Position
    - Speed
    - Acceleration
- Torque Sensor
  - Measures the torque applied to the floor by participants

- Optical Encoder
  - Measures the floor rings position

Electrical & Control

- Motion Control Software
  - Both the Chair with the Screen and the Floor Ring will move in coordination with the Virtual Reality Environment.
  - Manual speed control also available



Overall Goal

The overall goal of this research program is **to investigate what constitutes effective, robust, and intuitive human spatial orientation and behaviour.** This fundamental knowledge will be applied **to design novel, more effective human-computer interfaces and interaction paradigms** that enable similar processes in computer-mediated environments like virtual reality (VR) and multi-media.

iSpaceMecha

Collaboration between

SIAT iSpace Lab & **Mechatronics**

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