
Facilitating Multiple Target Tracking using Semantic Depth of Field (SDOF)

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Abstract

Users of radar control systems and monitoring applications have to constantly extract essential information from dynamic scenes. In these environments a critical and elemental task consists of tracking multiple targets that are moving simultaneously. However, focusing on multiple moving targets is not trivial as it is very easy to lose continuity, particularly when the objects are situated within a very dense or cluttered background. While focus+context displays have been developed to improve users' ability to attend to important visual information, such techniques have not been applied to the visualization of moving objects. In this paper we evaluate the effectiveness of a focus+context technique, referred to as Semantic Depth of Field (SDOF), to the task of facilitating multiple target tracking. Results of our studies show an inclination for better performance with SDOF techniques, especially in low contrast scenarios.

Authors Keywords

Semantic depth of field, moving targets, visual displays, visualization, blurring, preattentive cues, target tracking.

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ACM Classification Keywords

H.5.2 [Information interfaces and presentation (e.g. HCI)]: User Interfaces---Graphical User Interfaces, Evaluation/Methodology, User-centered design, Interaction styles.

General Terms

Experimentation, Human Factors, Performance.

Introduction

A significant amount of information used in the information sciences is represented using dynamic simulations and animations. These include the display of traffic control systems, video games, and interactive maps. The effectiveness of these systems depends upon techniques that facilitate viewing visual scenes that are dynamically updated.

With dynamic information, a significant concern is to track all the changes that occur simultaneously in the scene. For example, in an interactive map of a city in a car navigation system, the user may be interested in isolating several objects of interest, such as hotels. Although the maps display ample information, they do not facilitate the isolation of items of interest. As a result, the task of finding necessary information can be quite overwhelming and time-consuming (Figure 1). This is especially true when there exists varying levels of contrast between the targets and the background. It is therefore important to devise techniques that allow users to isolate and focus on elements of the display that are deemed important at any given time.

In this paper, we examine the effects of applying a focus+context technique, semantic-depth-of-field (SDOF), to allow users to visually parse dense visual

scenes. SDOF exploits the preattentive capabilities of the human eye such that elements of interest pop-out to the user. While SDOF was shown to be effective for preattentively processing information in static environments [3, 4], to the best of our knowledge there has not been any study investigating the benefits of this technique in dynamic scenes. Our primary contribution is the demonstration that SDOF can be an effective technique for tracking moving targets.



Figure 1. Look quickly! How many red targets can you pick out from the scene? This task requires significant visual resources to carry out. (appears better in color)

Related Work

Two areas of research specifically relate to this work: Multiple Target Tracking (MTT) and Semantic Depth of Field (SDOF).

Multiple Target Tracking (MTT)

There exist several contending theories that explain the mechanisms that our perceptual system employs for tracking multiple moving targets. Pylyshyn et al [6]

