Modeling 3D Frames of Reference for the Common Operational Picture

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ABSTRACT

The intent of the common operational picture (COP) is to provide a shared understanding of the battlespace to improve responsiveness and provide decision dominance. A fundamental problem for this shared understanding is the co-ordination of views on an information/knowledge space. We argue that this problem is related to the frame of reference *concept and present a framework for that concept that classifies those factors that improve or degrade performance when co-ordinating information across views of spatial data. We also consider similar display concepts from information visualization (depicting file structures, networks, the web, windows and other interface elements) and from display design guidelines from other domains (e.g., process control, medical imaging), and note the fundamental similarities. The relevant literatures underline a recurring need for depicting both global context and local content, which leads to the need for multiple displays, and methods for helping a user transition across multiple displays.*

1 INTRODUCTION

The intent of the common operational picture (COP) is to provide a shared understanding of the battlespace to improve responsiveness and provide decision dominance. The COP has been defined as the integrated capability to receive, correlate and display heterogeneous sources of information in order to provide a consistent view of the battlespace. Visualization technology offers a means to establish the COP and should help the commander transition across strategic, operational and tactical levels. The ultimate aim is to obtain an integrated visualization environment where commander and staff can gain a shared understanding of the changing battlefield situation.

Current technology provides a means to display tremendous quantities of data to the human commander. Geospatial data, sensor data, network data—electronic and human, socio-political data, data on troop status, materiel, data from news media, and so on. Further, the nature of the future operational environment requires a high degree of flexibility and adaptability, due to factors such as: asymmetric threat, enlarged areas of operation; non-contiguous and non-linear operations; requirements for a three-block war, use of complex terrain, and effects-based operations within a maneuverist approach [1].

To address this state of affairs, it is argued that the future commander can only be successful if the command team functions collaboratively. A rigidly hierarchical command structure is too slow and inflexible to respond in a timely manner to the nature of the asymmetric threat and resulting warfighting characteristics. There is a need therefore, to provide an integrated C4ISR system that supports

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collaborative working. This includes the design of computer software and displays to facilitate the collaborative working concept.

While co-ordinating information is shared across different echelons, commands, environments, government departments, and nations, the information available varies across such organizations, and is often represented and portrayed in different ways. A fundamental problem with the communication process for collaborative working is that of the co-ordination of views on an information/knowledge space. For instance, if a shared geospatial awareness is required—the platoon commander with troops on the ground looking at a group of buildings versus the company commander examining a 2D plan view (aerial photographs, maps) of the same urban terrain—it can be difficult for one commander to communicate to the other. In one view, task-relevant information may be visible; in the other, it may be invisible. Is the company commander aware of what is visible to the platoon commander? What is left and right in the forward field of view (FFOV) may be reversed with the map depending on orientation. If a shared understanding of network access data is required (e.g., a complex set of intrusion detection data) two analysts in different locations may have access to only limited views on the data but need a common representational format (e.g., a dynamic 3D graph) to communicate.

We argue that such problems are related to the *frame of reference* concept [2, 3, 4], and present a framework for that concept that classifies those factors that improve or degrade performance when co-ordinating information across views of spatial data. We also consider similar display concepts from information visualization (depicting file structures, networks, the web, windows and other interface elements) and from display design guidelines from other domains (e.g., process control, medical imaging), and note the fundamental similarities. In particular the relevant literatures underline a recurring need for depicting both global context and local content, which leads to the need for multiple displays. Further, since different viewpoints have various advantages and disadvantages for various operational contexts, there is a need to provide methods for improving *visual momentum* across displays. We note how such methods can be split into two basic types: those that allow both views to be show simultaneously (compromise displays) and those that ease the abrupt shift between global and local views by showing the mapping between display elements in the different views (transition displays).

This preliminary classification may ultimately lead to the appropriate use of display techniques that help the commander maintain good situation awareness across different levels of commands in the joint, interagency, multinational, and public (JIMP) context.

2 REFERENCES

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