Toward User-Centred Geovisual Analytics in Maritime Surveillance

Gabriel Vatin Aldo Napoli
MINES ParisTech, CRC
Sophia Antipolis, France
{gabriel.vatin, aldo.napoli}@mines-paristech.fr

1 Introduction

Within the domain of maritime safety and security, many operators and analysts are asked to manage huge set of real-time data. Information systems, such as Maritime Surveillance Systems, are used to visualize and analyse information of monitored vessels (e.g., AIS, RADAR). Past tracks, present states of vessels and contextual data, such as meteorology, are gathered in these visual platforms. Figure 1 gives an example of a visual platform used in maritime surveillance centres: multiple screens give specific information, using various displays. These visualizations are the results of the I2C project [3].

Analysis tools are integrated to these systems, and can be based on geographical queries, data comparison, trajectory prediction, etc. These tools enable to detect unusual behaviours at sea, potential risks alerts and suspicious vessels. The work of analysts is thereby improved. Previous research has shown that geovisualization and geovisual analytics improve anomaly detection and make knowledge discovery easier to human operators [1, 7, 8].

Figure 1: Multi-monitor interface for maritime surveillance (at CROSS-Med, Toulon)

2 Use and users issues in visual analytics

But visualizing this constant and massive data flood is still a major issue. Even if visual analytics can improve the use of surveillance systems, yet it can cause issues about their use. Indeed, visualizing traffic data with advanced technologies cannot fulfil its original goal - improve situation awareness - if used by a novice user in information visualization. Figure 2 gives an idea of basic graphs to visualize vessel movements (speed graph) or traffic in a specific zone (bar chart), easily understandable. Thus on the one hand, using advanced information visualization methods could be more effective for scientists; on the other hand, controllers could get confused.

Figure 2: FishEye platform: maps and graphs for vessels monitoring (CRC, MINES ParisTech)

Previous similar works in geovisual analytics highlighted new tools and methods improving data analysis. But the results were interfaces for specific needs or users, generally an analyst, and not suitable to all actors involved in control [6, 8]. The visualization methods and the needs of controllers are various, according to the situation that has to be faced and the person dealing with it. Therefore, a single method for modelling, visualizing or analysing maritime data will not suit every actor. Moreover, the profile and the experience of the end user will strongly affect his/her understanding and his/her manipulation of visual analytics. The accessibility of visualization methods depends on user's experience in statistics, computer graphics, knowledge of the data, etc.

A methodology must be developed, so that the most suitable visualization environments could be proposed to the user, with respect of the data types, the user's profile and the purpose of use.

3 Methodology

In order to deal with as many actors as possible and propose the most suitable visualization tools, based on their needs and experience, we propose a methodology for guiding the selection of geovisual analytics methods.

First, the usability of geovisual analytics methods must be evaluated, taking into account their final use and users. Davis's factors for evaluating technology acceptance [2] will be applied to visual analytics tools. Perceived ease of use (PEOU) and perceived usefulness (PU) would evaluate users' acceptance to visualization. These indicators would be used to qualify fitness for use and "quality" of visualization methods for each type of user.

Then, the requirements of users in maritime risk management and maritime surveillance will be formalized. This stage will be based on interviews with potential users, such as maritime controllers, analysts or researchers working in geographical risk management. The expectations of risk engineering should thereby be compared to visual analytics and visualization contribution. This study would allow matching existing visual analytics methods to the needs of controllers, according to the previous evaluation.

Finally, both results of visual analytics study and maritime risk management study will be gathered in a single decision system. This final stage will allow (1) collecting information about user's profile and available data as an input, and (2) generating a catalogue of most suitable visualization and visual analytics environments as an output.

4 Conclusion

To conclude, geovisual analytics provides powerful environments to analyse spatio-temporal data: nevertheless, they have to be adapted to the user's needs and experience with computer graphics and statistics. In the field of maritime surveillance, using the right tool to analyse data has major effects on the analysis time and on the results.

Therefore, we investigate the evaluation of visual analytics environments from use and users perspectives. The aim is to develop a methodology for helping the selection of most suitable (geo-)visual analytics tools. To respect the philosophy of visualization and data exploration, an interactive interface should propose several possible methods according to the user, the available data and the type of analysis. These visualizations could be synchronised maps, graphs or tables [4]. There shouldn't be one single visualization method, but a catalogue of available environments for the analysis to be led. This way, the user would always keep control on the type of visualization to use, rather than being proposed a single one: this is the key point in risk management [5].

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