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EDITORIAL

Applications of geographic information systems

Cédric Grueau[1]

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The papers appearing in this special issue of the Journal of Geographical Systems come from the first edition of an International Conference entitled 'International Conference on Geographical Information Systems: Theory, Applications and Management,' organized in Barcelona (Spain) on April 28–30, 2015. The purpose of this new International Conference is to create a meeting point for researchers and practitioners to address new challenges in geospatial data. This includes sensing, observation, representation, processing, visualization, sharing, and managing data, in all aspects concerning both information communication and technologies (ICT) and management information systems and knowledge-based systems. We would like to use this opportunity to thank the reviewers who contributed for the quality of this special issue with their thorough judgments and insights. Under the title 'Applications of Geographic Information System,' this issue aims to envision the way in which GIScience may contribute to cope with emerging challenges.

The issue is composed of four papers that are motivated by specific regional concerns. The four applications presented in these papers illustrate how researchers and practitioners provide solutions to challenges in heritage and conservation, risk forecast and management issues, urban planning, and the management of large infrastructure such as seaports.

The first paper in the issue is by Ragia, Sarri, and Mania and is motivated by the necessity of providing teams of historians, archaeologists, and engineers with tools for the restoration of important heritage and historical buildings. The solution presented makes use of tacheometry acquisition and computer graphics to build a 3D software framework that preserves the precision needed by expert users but remains fast to build and cost-effective. The framework uses a game engine to build

✉ Cédric Grueau
cedric.grueau@estsetubal.ips.pt

[1] Department of Systems and Information Technology, Setúbal School of Technology, Polytechnic Institute of Setúbal, Estefanilha, 2914-761 Setúbal, Portugal

a 3D reconstruction of an iconic historical building in Crete, Greece, where the conservation of heritage requires a lot of effort. The resulting model is integrated with surrounding geographical data, allowing expert users to navigate, query, and manipulate for precise distance estimation and visualization of restoration efforts. The approach proposed by the authors goes beyond other works in the domain of three-dimensional photorealistic reconstructions of archaeological structures mainly by focusing on the visualization and exploration aspect of the buildings. Following a more accurate but pragmatic approach, the authors are able to address the challenge of providing experts with an accurate 3D reconstruction. Coupling with the geographic context allows expert users to manage the restoration steps and foresee its impact in the surroundings.

The second paper in the issue, by Moniz, Rivero, Pino, Trujillo, and Núñez, is concerned with the management and visualization of large volumes of seaport data and resources. The ease of collecting, storing, and processing digital data may be leading to what some are calling the fourth paradigm of science, following the millennia-old tradition of empirical science describing natural phenomena, the centuries-old tradition of theoretical science using models and generalization, and the decades-old tradition of computational science simulating complex systems (Miller and Goodchild 2014). "Big data is data that exceeds the processing capacity of conventional database systems. The data is too big, moves too fast, or doesn't fit the strictures of your database architectures" (Dumbill 2012). Monitoring Seaport activities and their surrounding physical environment generates huge amounts of data, on which many stakeholders rely. These data are only valuable if it can be effectively processed and visualized. This second paper presents *Smartport*, a comprehensive online platform for the visualization and management of a seaport data, built as a GIS application. The solution uses "The Internet of Things," comprising sensors and spatially related objects, in data acquisition. The authors' challenge is not only on the volume of data, but especially on the variety and velocity at which georeferenced data are captured. This platform constitutes a step toward objectives raised by the ports community stakeholders in several occasions at the GreenPort Congress.[1] The Greenport community aims to effectively reduce the carbon footprint in ports while raising awareness to environmental considerations in this context.

The third paper in the issue, by Sabino, Poseiro, Rodrigues, Reis, Fortes, Reis, and Araújo, is concerned with the development of an early warning system for sea waves, which integrates assessment of risk and severity of the impact of the waves on coastal areas and infrastructures. Settlements in coastal lowlands are especially vulnerable to risks resulting from climate change. The so-called Low Elevation Coastal Zone (LECZ), defined as the contiguous area along the coast that is less than 10 meters above sea level, contains 10% of the world's population and 13% of the world's urban population (McGranahan et al. 2007). In this context, the work presented in this paper is particularly relevant. The interest of the system presented is twofold: it is a risk assessment tool combined with a warning system. With this platform, it is possible to predict the expected overtopping flow and consequent

[1] GreenPorts Conference http://www.greenport.com/congress.

flooding, which are critical for coastal and port areas protected by maritime structures, and to produce risk maps for long-term decision-making. The paper describes the advantage of using a software engineering approach, called software product lines, to help build a modular system which can adapt to different situations by replacing certain modules. On the other hand, the generic system can be instantiated to a specific application and location, according to the availability of the data necessary for the wave prediction model. For instance, if no real-time data about waves are available from the buoys, the system will use pre-run simulation models. The paper describes the instantiation of the system in different locations in Portugal, a region with a large extension of LECZ. These examples illustrate that the approach improves replicability and scalability in this type of emergency systems.

The final paper in the theme issue, by Maquil, Leopold, De Sousa, Schwartz, and Tobias, examines the applicability of technology to collaborative urban planning. Spatial and environmental planning systems are at the hearth of local concerns. Planners puzzle over how to manage our coexistence in shared spaces and local environments (Healey 1997). Collaborative or Participatory Urban Planning focuses on involving stakeholders and local community in the strategic and management processes of urban planning. This paper presents a framework to use geospatial tangible user interfaces (GTUI) in collaborative urban planning. The paper introduces the concept of Geospatial Tangible User Interfaces and describes its design and implementation. The physical interaction underlying GTUI contributes to actively engage all project members in the planning and control process by connecting them using information, communication, and collaboration modules. The two real-world case studies presented assess the usability of such a tool. These case studies show that a shared space, where experts and non-experts can interact with complex and technical information, can benefit the collaborative and participatory aspect of planning. They also demonstrate that designing a tool for both experts and non-experts requires a broad vision to accommodate many interacting users and additionally technical tools, supporting advanced interface technologies.

Together, these four papers are representative of a time where researchers and practitioners are building solutions that address challenges in which geographic information plays a key role. All the solutions provided in these four papers can be adapted or replicated to similar problems and different regions. We hope that this special issue will serve to illustrate how to cope with these challenges, acknowledging that spatial context matters.

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[2] http://insticc.org/.

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