Dynamic and Mobile GIS
Investigating Changes in Space and Time

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Like Stan Openshaw (1998) in the foreword to the ‘Innovations in GIS 5’, I have never been asked to write a foreword before, and also like him I am concerned that after you read this one (and who reads forewords anyway?) I may never be invited again. But, as readers of this foreword will be probably be sparse and perhaps limited to the kind of people that read the small print on the backs of cornflakes packets, I can take this opportunity to say more or less anything. So I choose to ruminate on GIS research as seen through the eyes of the very first 1993 GIS Research UK (GISRUK) conference (Worboys, 1994b) and the latest, as represented by contributions in this volume, and discuss one of my pet subjects: the rising star of time in GIS research.

GISRUK has become a teenager! In 1993, we set as an objective for GISRUK ‘to act as a focus in the UK for GIS research in all its diversity, across subject boundaries and with contributions from a wide range of researchers, from students just beginning their research careers to established experts’. There was at that time a need for a conference that brought together primarily UK researchers and students to discuss the state of GIS research. Indeed, in the original ‘Innovations…’ 26 out of 31 contributors were from UK institutions. In this latest volume, we count only 10 of the 31 chapter authors as UK-based. So, the conference, or at least the book it has generated has become internationally diverse.

So what are the current research preoccupations, as seen at GISRUK conference and in this volume? The thing that stands out for me, and this partly reflects a personal preoccupation, is the overwhelming importance now given to the temporal dimension in GIS. Time is now a significant partner with space, if not in GI systems, then certainly in the science of GI. Just as space provides the framework for describing the static objects in the world, so the temporal dimension is needed for occurrent entities, such as events and processes. Dynamic spatial phenomena require a mix of space and time, leading to so-called spatiotemporal information systems (STIS).

Hägerstrand (1970) had already noted the importance of the temporal dimension in geographical and socio-economic analysis, but it was in the 1990s that STIS really began to take off (Langran, 1993; Worboys, 1994a). Time in this volume has been promoted to the volume theme, ‘Dynamic and Mobile GIS’, with its focus on the event-oriented aspects of the world. An entire section is devoted to ‘Motion, Time and Space’, as well as an introductory essay on the technology of space and time (Maguire), discussions on process models (Rietsma and Albrecht) and events (Beard). Almost every chapter, from mobile GIS to disaster management applications, requires an understanding and efficient implementation of the temporal
dimension in spatial information systems. At last, time is finally being given its true place among those key topics for research in geographic information science.

It is clear that the integrated spatiotemporal dimension is beginning to play the role that 2-dimensional spatial geometry and topology played for GIS at its outset. Applications range from environmental event analysis, disaster management, defense, transportation, and the evolution of a topographic landscape. But whereas with space, the proprietary technology was quickly to hand, for the temporal dimension, even purely temporal databases, let alone spatiotemporal systems, are rare or even non-existent in the marketplace. As Maguire (Chapter 1) states, ‘We are just beginning to add support for reading and storing time-series data, but we are still someway off full 4D dynamic modeling within a commercial GIS.’ I believe that this is now a matter of timing and economics. The technology is becoming ready, but business cases still need to be made.

What are the current and future issues in STIS research? To my mind, still the really hard question, is what the underlying conceptual model looks like? Or, to use that hackneyed O-word, what is the upper-level ontology of dynamic geographic phenomena? The answer to this question is not just related to the structure of time, but also to the general kinds of dynamic entities that exist in the world: events, processes, actions, trajectories, etc., and how they are all interrelated. This question is still wide open.

GIS research, as presented at the GISRUK conference series, and enshrined in the ‘Innovations in GIS’ book series, is flourishing, and has moved from the relatively narrow national stage to encompass an international participation. Finally, from one of its parents, I wish GISRUK some happy adolescent years, and not too much teenage angst!

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References


Preface

This book’s title ‘Dynamic and Mobile GIS: Investigating Changes in Space and Time’, part of the Innovations in GIS book series, may need some explaining. The technology which will support Mobile GIS is rapidly gaining popularity and effectiveness (PDAs, wireless internet, internet-based GIS, 3G and 4G telecommunications). The application domain of Mobile GIS is wherever important geo-spatial events are taking place – not back at the office. That these events need to be recorded and analysed in situ implies that they are rapidly changing (hence dynamic) phenomena. This situation implies technological, databasing, display design and processing constraints requiring investigation and synergistic research and development. To us it seemed appropriate to produce a book linking these dynamic and mobile elements of Geographical Information Science.

Dynamic and mobile GIS is a research area full of good ideas. Some of these emerge from the constraints of current technology; for example, those that seek to solve the problems of limited display (e.g. Anand et al. in Chapter 9) or high volume data transmission (e.g. Li in Chapter 2). Other ideas emerge despite these constraints (e.g. Tsou and Sun in Chapter 12; Laube et al. in Chapter 14). Nevertheless, dynamic and mobile GIS is now an established idea, and, for those researching it, a technology exists that must be acknowledged and understood.

Excluding an Epilogue (Part V), there are four parts to this book. Each is briefly introduced below, although a fuller introduction is provided at the start of each part.

Part 1 - Technology for Dynamic and Mobile GIS – As Mobile GIS technology already exists we have decided to make this the first part of our book. Chapter 1 ‘The Changing Technology of Space and Time’ by David Maguire, sets the scene by providing an introduction and an overview of both the extant technology and hints of what is to come. This is done within the context of the evolution of: GIS, from 2D to 3D and now, by embracing the time dimension, to 4D; computer systems, from stand-alone systems to distributed, network-centric systems; and miniaturisation wherever more powerful processors are being built into increasingly smart, multi-functional, small and light devices. Chapter 2 ‘Opportunities in Mobile GIS’ by Qingquan Li expands on Maguire’s chapter. Li introduces the reader to a very large part of the technology without overwhelming with detail. Thus the reader is left knowing what they ought to know about, and is a most useful guide. Li is very optimistic about the future of mobile GIS and makes this clear through the presentation of successful applications and healthy business projections. Chapter 3 ‘Location privacy and location-aware computing’ by Matt Duckham and Lars Kulik rounds out the book’s Part I by raising issues to make us think about some of dynamic and mobile GIS’s implications. They suggest that the technology’s challenge to our security and privacy needs consideration, and present some solutions. Duckham and Kulik work with researchers active in many applications of spatial information systems for facilities and utilities management, emergency
Since the early 1970s, Esri has continued to develop GIS software technology supporting functional requirements identified by the GIS user community. Sensitivity to software development trends and enterprise architecture strategies provide guidelines for development investment. Esri software developers leverage the latest computer hardware and software technology to maintain leadership in the GIS marketplace. Resources are aligned to provide the best Mobile GIS integrates one or more of the following technologies: Mobile devices, Global positioning system (GPS), Wireless communications for Internet GIS access. Traditionally, the processes of field data collection and editing have been time consuming and error prone. Invasive species are an inherently dynamic and spatial problem—new infestations are being detected, and known ones are eradicated or change in size and density with treatment. In response, TNC’s efforts to fight invasive species focus on four strategies: prevention of new invasions, early detection and eradication of new infestations, treatment or restoration of infested sites, and education and outreach to inform policy makers and the public.