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BOOK REVIEW

Manfred M. Fischer, *Spatial Analysis and Geocomputation*, Springer Verlag, 2006

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In 2007 Manfred M. Fischer, Professor of Economic Geography at Vienna University of Economics and Business and one the top contemporary regional scientists, with a tremendous contribution to the development of Regional Science, celebrated his 60th anniversary. On this occasion he received a long series of honours: among them, the Fellow Award for the outstanding contribution and dedicated leadership to the field of Regional Science from the Regional Science Association International and a recognition in his honour by a special issue of the Review of Regional Studies. The Romanian Regional Science Association also bestowed upon Manfred M. Fischer a certificate of appreciation in recognition of his invaluable support to the development of the Romanian RSA and its integration in the international Regional Science community.

In another register, Springer Verlag launched on the same occasion two books of selected essays of Manfred M. Fischer. The Romanian Journal of Regional Science has the privilege to publish in this issue the review of both books.

The book ***Spatial Analysis and Geocomputation*** highlights a new computational-intensive paradigm, that of geocomputation, which is able to contribute to a radical change of the current research practice in spatial analysis. It is based on the latest developments in estimation theory, model selection and testing: from the very beginning is underlined the aim of providing new insights into neural networks, as advanced tools for non-parametrical modelling and spatial interaction modelling.

Accordingly, the book is structured into four parts, which address the proposed topic gradually, from the spatial analysis and Geographic Information Systems (GIS) to computational intelligence in spatial data analysis, geocomputation in remote sensing environments and, finally, to new frontiers in neural spatial interaction modelling.

After Introduction, in **Part I** - *Spatial Analysis and GIS*, **Chapter 2** focuses on spatial analysis in geography, discussing the crucial role of spatial data analysis in the detection of patterns and exploration and modelling of the relationships between these patterns and the understanding of the processes behind them.

Chapter 3 approaches spatial interaction models and their role in GIS, explaining the usefulness of GIS functionalities in three steps of the modelling process, namely zone design matrix building and visualisation.

Chapter 4 envisages data model and design issues that are specifically oriented to the application of GIS to research, planning and management in transportation, identifying various improvements of the traditional network data model that are required to support advanced

network analysis in a ground transportation context. They refer to turn-tables, dynamic segmentation, linear referencing, traffic lines and non-planar networks.

In **Part II -** *Computational Intelligence in Spatial data Analysis***, Chapter 5** addresses the expert systems and artificial neural networks for spatial data analysis and modelling as essential components for knowledge-based GIS. It highlights the differences between spatial expert systems and artificial neural networks, stressing the idea that neurocomputing shows greater flexibility than expert systems to deal with situations typical for the GIS and expressing the opinion that "the future might bring shared geoprocessing with expert systems and artificial networks, genetic algorithms and fuzzy logic, especially when GIS are implemented on large multi-processor systems" (p.75).

Chapter 6 refers to computational neural networks as tools for spatial data analysis, offering valuable topics for both students and professional researchers, which point out the properties of the processing elements, the network topology and learning in the network.

Chapter 7, written with Sucharita Gopal, proposes a new approach to modelling interregional telecommunication flows via artificial networks. It represents a clear break with traditional methods that explain spatial interactions, being based on a general nested sigmoid neural network model. The feasibility of this model is demonstrated in the context of modelling interregional telecommunication traffic in Austria, its performance being evaluated in comparison with the classical regression approach and gravity type.

Chapter 8, written with Yee Lung, concentrates on evolutionary computational neural network (CNN) based on genetic algorithms for modelling spatial interaction data. It considers this problem as a global optimisation problem proposing a new approach that "embeds back-propagation learning into the evolutionary paradigm of genetic algorithms" (p.128). In order to illustrate its performances and to evaluate its robustness the approach has been applied to the family of three inputs, single hidden layer, single output feedforward CNN models using interregional telecommunication traffic data in Austria.

Part III offers a spotlight on *Geocomputation inRemote Sensing Environments*, more specifically on adaptive spectral classifiers as implemented with backpropagation networks, radial basis function networks and fuzzy ARTMAP.

Chapter 9, witten with Sucharita Gopal, Petra Staufer and Klaus Steinnocher, focuses on the evaluation of neural patterns classifiers for remote sensing application. The main task of the multispectral pattern classification is to assign pixels to one of eight prespecified urban land use categories on a pixel-by-pixel basis. The research has been based on four classes of simulations so as to illustrate the properties of the classifier in general as well as the stability of results with respect to control parameters.

Chapter 10, written with Petra Staufer, discusses the question of optimisation in an error backpropagation neural network environment with a performance test on a spectral pattern classification problem. It aims to develop a mathematically rigid framework for the minimisation of the cross-entropy function in an error backpropagation framework. To this end it investigates different techniques for the optimisation of the multiple-class cross-entropy error function to train

single hidden layer neural network classifiers with softmax output transfer functions in the realworld of the multispectral pixel-by-pixel classification problem.

Chapter 11, written with Sucharita Gopal, is placed in the area of the Adaptiv Resonance Theory of Carpenter and Grossberg (1987), which provides a large family of models and algorithms in spite of limited analysis of their properties in the realworld. Manfred Fischer and Sucharita Gopal make a step forward in this respect, the chapter describing design features system dynamics and simulation algorithms for the corresponding learning system, which is trained and tested for the classification of the multispectral image of the Landsat-5 Thematic Mapper scene from the city of Vienna on a pixel-by-pixel basis.

Part IV has selected three papers in order to highlight the advances towards *New Frontiers in Neural Spatial Interaction Modelling*.

Chapter 12, written with Martin Reissmann and Katerina Hlavackova-Schindler, proposes a novel neural approach for the case of origin or destination - constrained spatial interaction flows. The authors demonstrate the efficiency of this approach using Autrian interregional telecommunication traffic data.

Chapter 13 addresses the learning process in neural spatial interaction models from a statistical perspective. The Alopex based global search is employed – as opposed to local search based upon backpropagation of gradient descents, each in combination with the bootstrapping pairs approach, this study demonstrating the superiority of the Alopex based global search, measured in terms of Kullbach and Leibler's information criterion.

Chapter 14, written with Martin Reissmann, develops a methodology for neural spatial interaction modelling in a mathematically rigid and unified framework. In comparison with the current practice in neural network modelling, which seems to suffer from the least squares and normality assumptions, this study suggests a more suitable estimation approach, namely maximum likelihood estimation under more realistic distributional assumptions of Poisson processes and employs a global search procedure – Alopex in order to solve the maximum likelihood estimation problem.

The whole book appears as an impressive collection of essays which proposes not only a wide range of approaches to spatial analysis and geocomputation, but also a novelty of solutions to the problems identified, trained and tested in the case of Austria. Therefore the book is strongly recommended to all experts who aim at using geocomputation models and techniques for solving real world problems.

At the same time with sincere congratulations for this great achievement, I would like to express Professor Manfred M. Fischer my entire gratitude for the opportunity to pay a couple of visits to the Institute of Economic Geography and GIScience, whose director he is, which offered me the chance of a wide, deep view, "from inside", of the laboratory where the very challenging ideas expressed in the book have been developed.