Book Review

Dynamics, Synergetics, Autonomous Agents. Edited by W. Tschacher and J-P.
   Dauwalder. World Scientific, Singapore 1999, xiv + 320 pages. ISBN
   981-02-3837-1.

   This book is written by a collection of physical and social scientists who
are approaching cognitive science using models that include neural networks,
synergetic systems and nonlinear modelling. The editors state their purpose
as helping to "synchronize and integrate the progress made in both cogni-
tive psychology and new artificial intelligence." Tim van Gelder states the
problem by juxtaposing two hypotheses: the computational hypothesis that
"Cognitive agents are digital computers and can be scientifically understood
as such," and the dynamical hypothesis that "Cognitive agents are dynamical
systems, computers and can be scientifically understood as such." Hermann
Haken's foreword observes "the mind . . . can be studied by model systems
using robots." What we observe here is the rebirth of the much derided
"machine metaphor" where the agent is at once autonomous and a machine.
As Mary Shelley may have said, "May you live in interesting times."
   The book opens with a chapter by Haken that is a clear exposition
using synergetics and uses examples of face and emotion recognition. This
chapter introduces a section of the book that concentrates on mathematical
formalism and demonstrates how this can be used to explain complexity
theory using stochastic graph analysis and higher order entropy functions.
The two most important papers in this section are those by Shiner et al.
and Haken. The first of these shows that it is possible to define complexity
using information theory. The second by Haken is an ambitious attempt to
describe human creativity using synergetic theory. The idea, although highly
speculative, is worthy of much further research.
   The second part of the book attempts to model cognition using au-
tonomous agents as the basic structures and interaction between these agents
to produce the rich field of cognition. The ideas are based on theories of
complexity and emergent systems with ideas borrowed from chaos theory
however the papers are weak on mathematical rigor and the reader is asked
to take many ideas on board without strong empirical evidence.

Eiser suggests that consciousness might be a representation of self within a self-organizing system. He uses the Hopfield model to simulate this behaviour although there are no experimental results presented only some tentative conclusions. The rest of this section discusses fractal behaviour, psyche, some aspects of schemata which, although not explicitly stated, can also be seen as neural net simulations. Throughout the section, ideas drawn from the physical sciences such as symmetry breaking, phase transitions etc. are used without any discussion of the appropriateness of the analogies.

The third part deals exclusively with cognitive science in terms of autonomous agents ie self-sufficient systems which have the goal of using the local rules in the process of creating emergent behaviour. This contrasts with classical thinking where results are seen to emerge from information processing which is independent of any physical implementation. The physical models used are those of robots finding and classifying objects and navigating around them. The best article in this section, by Glasser and Morignot, involves societies of autonomous agents and their organization. Other areas covered included interaction of dynamic agents in their environment and the concept of collective intelligence. The section is interesting but hard work.

The last section of this book is the most enjoyable. It includes applications of catastrophe flags in personally relevant decisions, synergetic organization in speech rhythm and hierarchical dynamics in work organizations. The first of the articles uses simple catastrophe theory and explains how the theory can be used to explain changes in health states and human decision making. The second article reports research where subjects were asked to repeat phrases containing multiple prominent or stressed symbols in unison. Here Cummins is able to show that a model of hierarchically coupled oscillators is unable to explain human behaviour. Guastello presents an interesting model of hierarchical dynamics affecting work performance in which a nonlinear model is used to explain differences in performance. This work is an extension of many years' hard work in field, which is summarized in his recent book.

This book is an introduction to a highly diverse field but the lack of the linkage between the sections makes the formulation of some comprehensive picture difficult. On balance, this reflects the problem that emerges when editors do not have a tight control over the contents of each article. This book is recommended for a library but not for a personal collection.

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