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FOREWORD

This volume contains the proceedings of a workshop on Analog Integrated Neural Systems held May 8, 1989, in connection with the International Symposium on Circuits and Systems. The presentations were chosen to encompass the entire range of topics currently under study in this exciting new discipline. Stringent acceptance requirements were placed on contributions: (1) each description was required to include detailed characterization of a working chip, and (2) each design was not to have been published previously. In several cases, the status of the project was not known until a few weeks before the meeting date. As a result, some of the most recent innovative work in the field was presented. Because this discipline is evolving rapidly, each project is very much a work in progress. Authors were asked to devote considerable attention to the shortcomings of their designs, as well as to the notable successes they achieved. In this way, other workers can now avoid stumbling into the same traps, and evolution can proceed more rapidly (and less painfully).

The chapters in this volume are presented in the same order as the corresponding presentations at the workshop. The first two chapters are concerned with finding solutions to complex optimization problems under a predefined set of constraints. The first chapter reports what is, to the best of our knowledge, the first neural-chip design. In each case, the physics of the underlying electronic medium is used to represent a cost function in a natural way, using only nearest-neighbor connectivity.

Chapters 3 and 4 are concerned with sophisticated nonlinear processing of time-domain signals. In both cases, this processing is carried out in real time, with only a small expenditure of energy per unit computation.

Chapters 5 and 6 describe two of the many projects currently under way to create electronic "neural networks" of the kind often modeled on digital systems. The success of these and other programs focused on the same goal will expand by many orders of magnitude the range of problems accessible to neural network solutions.

Chapters 7 through 10 contain reports of self-contained system chips that perform various kinds of image processing. In each case, the chip contains its own array of phototransducers; the input signals are extracted directly from an optical image focused directly on the chip's surface. Each project is directed at a particular aspect of image analysis. Each is, in its own way, inspired by the organization of the visual system of higher animals.

In aggregate, these chapters give a remarkable portent of things to come. It is clear that the continued evolution of this technology will produce systems possessing characteristics that emulate many of the remarkable properties observed in living systems, but that we have been unable to attain using existing engineering techniques.

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