HIERARCHICALLY INTELLIGENT MACHINES

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To my father ***Nicholas***

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PREFACE

The Theory of Hierarchically Intelligent Machines originated some forty five years ago when, as a new graduate of the Athens Polytechnic, I was asked to design a "electric shaft" to raise an overflow door of a dam in Greece. The door had two motors at either end and needed to be connected for synchronization. The answer was to install two "synchroes" or synchronous three phase machines with connected rotors. This project introduced me to the concepts of Control Engineering to which I devoted the rest of my career. Intelligent Control came into the picture in 1971, when K. S. Fu coined the name for the area beyond Adaptive and Learning Control which was fashionable at that time. Its theory took shape after long discussions with Norm Caplan at our office at NSF in 1973. Intelligent Machines came later into the picture when I tried to integrate the areas of application of Intelligent Controls.

From the first years of my control experience I tried to venture into more areas more advanced in intelligence, like Adaptive and Learning Control, which were taboo in the sixties. Work in System Identification, Parameter and Performance Adaptive algorithms led into the area of Self-Organizing Control which was also the title of my first book. The idea was to collect all the methods that would provide the ground of utilizing the control experience in areas inside and outside of engineering with minimal interaction with human operators. Intelligent Control was the natural extension of this effort. Robotic systems, especially with applications to Space exploration, where it was needed, was a parallel effort in order to establish the validity of the theory. Within the limits of this work I organized the IEEE Robotics and Automation Society, the Intelligent Control Committee of the Control Systems Society, and several IFAC, Control and Robotics Conferences and Symposia. As a generalization of this effort was the extension of the theory to Intelligent Machines, with major applications to prosthetic devices, and Intelligent Manufacturing. In the meanwhile Entropy came into the picture as an integrating measure among the various engineering and non-engineering fields and an appropriate theory was developed.

I then established a pioneering, NASA supported Center for Intelligent Robotic Systems for Space Exploration, CIRSSSE, at RPI, with ten professors and fifty students, and a one and a half million dollar laboratory facility. The center, in its five year existence, produced a large number of papers, technical reports and especially remote space truss assembly from the NASA Space Center at Houston, without the interference of a human operator. An Intelligent Manufacturing application for product scheduling was also performed by a student in Greece, to show the generality of the theory of Intelligent Machines.

This book summarizes the Theory of Intelligent Machines, and should be used to explore its capability to apply to engineering as well as various soft sciences, like biotechnology, ecology, pollution control and waste management, evolutionary biology, economics, etc. It is hoped that young researchers as well as professionals will pick up the flag and carry the whole Theory and Applications to new frontiers. At this point I want to thank all my students and colleagues who have contributed to the development of the material presented in this volume and especially my wife Youla whose patience and understanding made this book possible.

George N. Saridis PhD
Loudonville NY
February 2001