

Contents

I. Basic Considerations	1
I.1. Task description	1
I.2. Information processing and memorization in neuronal networks (microintelligence)	3
I.3. Human problem solving strategies with respect to actions (macrointelligence)	6
I.4. The learning control loop due to E. Erşü	9
I.5. Comparison of adaptive and learning control	13
I.6. Short review of related work	17
I.6.1. Calculation versus memorization	18
I.6.2. Neural network models and related theories	19
I.6.3. Concepts for imitation of human process control abilities	22
I.7. Recapitulation	25
I.8. Literature	25
II. Microintelligence	29
II.1. The cerebellar model of J. S. Albus	29
II.1.1. Neurophysiological background	29
II.1.2. Translation of the neurophysiological findings into a model implementable on a computer	31
II.2. AMS - a computer oriented effective implementation of the cerebellar model of J. S. Albus	38
II.2.1. Introductory remarks	38
II.2.2. The first mapping: Numerical input value characterization	39
II.2.3. The second mapping: From matrices to memory locations	45
II.2.4. The third mapping: Construction of the memory responses/outputs	48
II.2.5. Performance	53
II.3. Results with some test functions	56
II.3.1. Test functions and quality assessment criteria	56
II.3.2. Effects of various parameter variations	59
II.3.3. Noise filtering	65
II.4. Theoretical considerations	66
II.4.1. Basic properties	66
II.4.2. Storage capacities	68
II.4.3. Convergence	70

III.2. Hierarchies and alternative structures	152
III.2.1. Structures for and preliminary experiences with LERNAS hierarchies	152
III.2.2. Changes and alternatives to LERNAS	162
III.2.2.1. Prestructuring of the locally generalizing memories	162
III.2.2.2. Results with a prestructured controller	166
III.2.2.3. Simplifications	172
III.2.2.4. Results achieved with MINLERNAS	174
III.2.2.5. Results achieved with Miller's learning control loop	177
III.3. Real-time application of learning control loops to pilot plants	183
III.3.1. Modifications for real-time, on-line control	183
III.3.2. Control of a binary distillation column pilot plant with LERNAS	186
III.3.3. Control of an air conditioning system with Miller's approach	189
III.4. Recapitulation	199
III.5. Literature	199
Conclusion and remarks on further research topics	202
Index	204