HIDENORI KIMURA *Chain-Scattering Approach to H^∞-Control*, Birkhäuser, Boston, (1997) ISBN 0-8176-3787-7, x+246 pages.

Since modern control theory emerged in the 1960s and 1970s many approaches were proposed. Some were very abstract, some were very heuristic. The youngest approach is H^∞ control which was founded in the early 1980s and became widely accepted since the 1990s. Maybe one of the reasons for its success is that it can be seen from many different viewpoints.

The control problem considered here is to design a controller in the feedback loop of a plant such that the closed loop transfer function has an H^∞ norm which is bounded by a positive constant.

The approach of chain scattering matrices (CSM) is possible by recasting this problem in a scattering formalism where an appropriate load (the controller) has to be found. In the classical approach of scattering systems, the scatterer is represented by a scattering matrix, which has the disadvantage that a cascade of scatterers is described by a complicated star product of the scattering matrices. By a rearrangement of inputs and outputs, the scatterer can be equivalently described by a CSM and then the cascade is simply obtained by performing the usual matrix product of the CSM. By the transformation of scattering matrices to CSM however, one has to deal with a symplectic geometry. For example losslessness of the scatterer is expressed by the unitarity of the scattering matrix, while it is translated to (J, J')-unitarity of the CSM where J and J' are some indefinite signature matrices. This extra complication is however amply compensated by the simplicity of dealing with CSM. For example the computationally efficient algorithm (which is basically the Nevanlinna-Pick algorithm) to factor a CSM in elementary factors allows for an easy realization of the scatterer as a cascade of elementary sections.

A large part of this book is devoted to a gentle (since the exposition is self contained and requires only some knowledge of simple linear algebra) introduction to the algebra and analysis of CSM. The control problem is translated as: can a matrix function G (representing the closed loop system) be factored as a product of a (J, J')-lossless matrix Θ (representing the plant) and a unimodular matrix Π (representing the controller). Stabilization is obtained by J-lossless conjugation etc. In fact all such properties are discussed without the control interpretation, which is only given in the last third of the book.

The text is written at a graduate course level and includes many exercises. It is the only available textbook which brings together this material at a level of control engineers and engineering students. It is accessible and acceptable for practitioners as well as for academic control researchers. It is a pity though that there is no keyword index provided at the end of the book.

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