ABSTRACT

This dissertation deals with the Expanding System Problem (ESP). Specially, the two major classes of Connectively Stable ESP (CSESP) and Connectively Unstable ESP (CUESP) are addressed. Most of the problems in real large scale interconnected systems come under these two categories. For the more saturated class of CSESP, subsystem-level state feedbacks are advocated. Two numerically reliable parallel pole placement algorithms are presented. The parallel algorithms are tested on benchmark problems to show their robustness with respect to closed loop pole assignment. Constructive procedures are given to compute the feedback matrix. The second algorithm uses a unique partitioning of the desired set of eigenvalues and can handle any prescribed set. The relatively new and the more general class of CUESP constitute the other part of the work. The Stable Exact Model Matching Problem (SEMMP) is extended to handle solutions over the ring of stable transfer function matrices. This result is shown to have bearing on sufficient conditions of decentralized stabilizability for CUESP. A new interpretation of the existing sufficient condition provides explicit solutions to certain equations which can be used in designing the controller. The necessary and sufficient condition for decentralized stabilizability of CUESP is established for the first time in this thesis. The problem is shown to be equivalent to division in a *Proper Euclidean Domain* and the solution set characterizes the full class of compensators. The framework in which this problem is solved can tackle a broader class of systems (i.e., systems having direct feedthrough terms) than the class addressed in the existing literature. A direct byproduct of this insight is a broader sufficient condition and a simpler proof of the existing conditions. The General Expanding Systems Servomechanism Problem (GESSP) is completely solved in this thesis. The three subproblems of Expanding System with Tracking (EST), Expanding System with Disturbance Rejection (ESR) and Expanding System with Tracking and Disturbance Rejection (ESTR), where in addition to ESP the local new subsystem is required to track and/or reject arbitrary deterministic signals are solved. Necessary and sufficient conditions are established where existing literature could solve only a restricted ESSP problem (RESSP) in which only step signals were considered and sufficient conditions were provided.