Preface

This monograph presents the recent results obtained by us on the analysis, synthesis and design of systems described by linear equations. As is well known, linear equations arise in most branches of science and engineering as well as social, biological and economic systems. The novelty of our approach lies in the fact that no models of the system are assumed to be available, nor are they required. Instead, we show that a few measurements made on the system can be processed strategically to directly extract design values that meet specifications without constructing a model of the system, implicitly or explicitly. We illustrate these new concepts by applying them to linear D.C. and A.C. circuits, mechanical, civil and hydraulic systems, signal flow block diagrams and control systems. These applications are preliminary and suggest many open problems. We acknowledge many productive discussions with our colleagues A. Datta, Hazem Nounou, Mohamed Nounou and our graduate students Ritwik Layek and Sirisha Kallakuri.

Earlier research by us has shown that the representation of complex systems by high order models with many parameters may lead to fragility, that is, the drastic change of system behaviour under infinitesimally small perturbations of these parameters. This led to research on model-free measurement-based approaches to design. The results presented in this monograph are our latest effort in this direction and we hope they will lead to attractive alternatives to model-based design of engineering and other systems. We also anticipate applications to robust, adaptive and fault tolerant control.

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