

Preface

Two-dimensional (2-D) systems have received tremendous research attention since they have extensive applications in image processing, seismographic data processing, thermal processes, and water stream heating. Many important methodologies and techniques have been developed for analysis and synthesis of 2-D systems including stability and performance analysis, robust control, robust filtering, and fault detection problems. This book presents the research work on some classes of 2-D systems, that is, the system parameters are subject to uncertain, stochastic and parameter-varying changes, and the system states are subject to time-delay. Specifically, the considered 2-D systems include 2-D uncertain systems, 2-D state-delayed systems, 2-D Markovian jump systems, and 2-D linear parameter-varying (LPV) systems. Some sufficient conditions are first established, respectively, for the stability and performances (such as $\mathcal{H}_\infty$, $\mathcal{H}_2$, ℓ_2 - ℓ_∞ , and mixed $\mathcal{H}_2/\mathcal{H}_\infty$) of these classes of 2-D systems in terms of solution of linear matrix inequalities (LMIs). Based on the derived analysis conditions, the synthesis problems such as control, filtering, fault detection and model approximation, are addressed. In addition, we also make considerable efforts to investigate a special kind of 2-D system, namely linear repetitive processes (LRPs). A set of methodologies and techniques are proposed for analysis and optimal synthesis of LRPs.

This book aims to present up-to-date research developments and novel methodologies on 2-D systems. The content of this book can be divided into two parts. The first part is focused on general theory and methodologies for filtering and control of the considered 2-D systems. The second part presents the parallel results for the differential and discrete LRPs. These methodologies provide a framework for stability and performance analysis, robust controller design, robust filter design, and model approximation for the considered systems. Solutions to the design problems are presented in terms of LMIs. In addition, this book provides valuable reference material for researchers who wish to explore the area of 2-D systems, and the main contents of the book are also suitable for a one-semester graduate course.

The compendious frame and description of the book are given as follows. The main contents of the first part include: Chap. 2 is concerned with the robust $\mathcal{H}_\infty$ filtering for 2-D state-delayed systems; Chap. 3 studies the optimal $\mathcal{H}_\infty$ and ℓ_2 - ℓ_∞ filtering for

2-D LPV systems; Chap. 4 addresses the fault detection problem for 2-D Markovian jump systems; Chap. 5 studies the dynamic output feedback (DOF) control of 2-D LPV systems; Chap. 6 considers the sliding mode control (SMC) problem of 2-D Systems; and Chap. 7 investigates the model approximation of 2-D state-delayed systems. The main contents of the second part include: Chap. 8 investigates the robust $\mathcal{H}_\infty$ filter design for differential and discrete uncertain LRPs; Chap. 9 is concerned with the reduced-order $\mathcal{H}_2$ filter design for discrete LRPs; Chap. 10 studies the mixed $\mathcal{H}_2/\mathcal{H}_\infty$ fault detection problem for discrete LRPs; Chap. 11 addresses the DOF control problem for differential and discrete LRPs; Chap. 12 investigates the quasi-SMC of differential LRPs with unknown input disturbance; Chap. 13 studies the Hankel-norm optimal model approximation of differential and discrete LRPs; and Chap. 14 summarizes the results of the book and discusses some future work.

This book is a research monograph whose intended audience is graduate and postgraduate students as well as researchers.

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