Hovakimyan, Naira; Cao, Chengyu *** 1214.93004**
$\mathcal{L}_1$ adaptive control theory. Guaranteed robustness with fast adaption.
Advances in Design and Control 21. Philadelphia, PA: Society for Industrial and Applied Mathematics (SIAM) (ISBN 978-0-898717-04-4/pbk; 978-0-89871-937-6/ebook). xix, 317 p. £ 58.00; $ 85.00 (2010).

The book is devoted to L_1 adaptive control systems which should guarantee robustness in the presence of fast adaptation. The most important application area expected by the authors is adaptive flight control. The L_1 adaptive control can be treated as a modified model reference adaptive control where the structure is based on the idea of internal modeling. The book consists of six chapters and three appendices. In the first chapter the authors introduce the reader into the history and main features of adaptive control systems emphasis onto model reference adaptive controllers. The second chapter is devoted to L_1 adaptive control of matched systems with uncertainties. The problem of guaranteed stability and performance of the systems with fast L_1 adaptation is discussed. The relationship between performance bounds of the system and the rate of adaptation and the bandwidth of a linear filter used to shape the nominal response is found. For the design of the adaptive controller linear matrix inequality based software is used. The special cases of uncertainties resulting from unknown system input gain, unmodelled actuator dynamics, partially unknown nonlinear dynamics are discussed and the design procedure is illustrated by numerical examples. The third chapter deals with models with unmatched uncertainties and two adaptive control laws are proposed in this case. The former is based on the transformation of the model with unmatched uncertainties into an equivalent semilinear system with time-varying unknown parameters and application of the previously considered L_1 adaptive controller. The latter uses a fast estimation scheme based on a piecewise constant adaptive law. L_1 adaptive output feedback controllers are discussed in chapter 4. The design procedures are based on their counterparts proposed for the state feedback L_1 adaptive control systems but the conditions of guaranteed stability and performance are more restrictive. Chapter 5 is devoted to time-varying reference systems which should be treated by other mathematical tools than previously analyzed systems. The line of reasoning uses Lyapunov type techniques and differential inequalities. The last chapter deals mainly with the application of the proposed design techniques to the adaptive flight control. The authors also discuss difficulties and open problems. The appendices cover mathematical tools used in control system theory, projection operators for adaptation laws and algebras of linear matrix inequalities. The book may be of interest for students of graduate courses in advanced control and engineers who want to apply modern design techniques. In my opinion however the weakness of the book is its limited and one-sided survey of the bibliography related to L_1 control [see e.g., *M. A. Dahleh* and *I. J. Diaz-Bobillo*, Control of uncertain systems. A linear programming approach. Hemel Hempstead: Prentice Hall (1995; Zbl 838.93007)]).

A. Świerniak (Gliwice)