

Robust Adaptive Control: Where Are We? Where Should We Go?

Organized by:

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The field of Adaptive Control has experienced a rapid growth and change during the last decade with new ideas, concepts, methodologies, theories and applications. New approaches to “robustify” the classical Model Reference Adaptive Control (MRAC) and the Self-Tuning Regulator (STURE) have been developed. A growing number of adaptive architectures employing multiple models have been proposed such as Supervisory Switched Multiple Model Adaptive Control (SMMAC), Unfalsified Control (UC), and Robust Multiple Model Adaptive Control (RMMAC). Some of these architectures will be applicable for adaptive control problems involving nonlinear plants.

The above adaptive methodologies and architectures have evolved from different theoretical perspectives (some deterministic and some stochastic) and their interrelationships remain to be discovered. Moreover, all current approaches rely upon advances in stability theory, non-adaptive robust feedback compensator design, system identification methods, deterministic observers, and Kalman filters. All attempt to prove robust stability under special assumptions while others also focus upon robust performance as well. . Very often, the associated theory is confined to linear plants and controllers.

These new approaches to Adaptive Control have been driven by a wealth of application with high-performance requirements. Some of these applications permit complex and computationally intensive control algorithms due to their low sampling rates, whereas others pose severe computational constraints. Computational complexity thus play an important role in selecting appropriate control methodologies for specific application areas.

We hope that these two panel sessions will form a catalyst that will lead to a more unified understanding of the adaptive control problem for both SISO and MIMO systems, including the extension of existing knowledge in a systematic way to encompass adaptive control of nonlinear systems. The state of the art should be related to other relevant research directions. For example, we believe that future research should investigate the relationship of existing adaptive methods to the emerging field of Linear Parameter Varying (LPV) systems (which attempt to formalize the time-honored gain-scheduling method used in a myriad of practical control systems). Also, it is self evident that advances in system identification, robust control synthesis and stability theory are of particular importance to advances in adaptive control.

In order to accomplish the above objectives we have invited a number of expert researchers in the adaptive control field as well as experts in the related areas of system identification, robust control, stability theory and LPV systems to actively participate in

the panel discussions. In addition, we have invited researchers that will discuss future potential application areas for adaptive control.

The ECC07 panel sessions as follows:

Panel Session #1: Robust adaptive control: where are we now?

Panel Session #2: Robust adaptive control: what should we do next?

In Panel session #1 a subset of the invited researchers will present a brief summary of their current research. Their presentations will be critiqued by other panel members and enhanced by active audience participation.

Each speaker was instructed to address, to the extent possible, the following issues:

- (1). The architecture/philosophy/methodology of their adaptive system
- (2). Presence of unmodeled dynamics?
- (3). Presence of unmodeled disturbances?
- (4). Presence of measurement noise?
- (5). Command-following?
- (6). Time-varying (slow) uncertain parameters?
- (7). Applicability to SISO, MIMO designs or both?
- (8). Simulations and/or real applications experience?
- (9). Local and/or global stability results?
- (10). Computational requirements?

The presentations will concentrate on the philosophy and methodology with minimal mathematical equations.

In Panel Session #2 a subset of the invited researchers will present their views on future research and advanced applications. A general, hopefully spirited, discussion by other panelists and the general audience will follow.

Most speakers have submitted to the ECC proceedings an extended abstract and a list of references related to his/her presentation.