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Neurocontrol of an Aircraft: Application to Windshear

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Abstract—In this report, we consider the part of our work which concerns the design of neuroidentifiers and neurocontrollers which attenuate the effects of disturbances. Examples for linear-systems identification and disturbance rejection, as well as nonlinear control of an aircraft encountering wind shear on take-off are briefly discussed, and the following three problems are addressed.

1. System identification via dynamic neural networks.
2. Disturbance attenuation via memory neurons.
3. Aircraft control in the presence of wind shear after takeoff.

Keywords—Dynamic neural networks, Robust control of nonlinear systems, Aircraft control, Systems identification and control.

1. INTRODUCTION

The lack of rigorous mathematical representation of control systems in current paradigms of feed-forward and recurrent neural networks is a drawback to the development of research on neural networks for control. The feed-forward networks are known to work as a mapping between two information domains. Most of the current research in neurocontrol and related publications discusses this type of architecture for learning a model or a controller, which is usually either nonlinear or difficult to implement. The published results show that while these approaches yield satisfactory results in many cases, there is little development in relating the theories of classical and modern control systems to neural networks. Neural networks are usually treated as "Black Boxes" and thus, there is no direct contact with the "internal" information of the "Box." A linear control system, which may also be called a "Black Box," can be represented by transfer functions, matrix fraction representations, and/or other input-output, as well as frequency response parametrizations. Therefore, the input-output relationship, as well as performance, can be studied thoroughly. In our previous work [1–5], the "internal information" of the network is parametrized as a control system; the goal has been to represent the identifier and the controller in terms of this information, and thus integrate two types of dynamic neural network architectures into controllers. Suitability of feedforward architectures with dynamic neurons for identification

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