

*The AAE Spring 2010 Colloquium Series*

**Steering UAV'S with Neural Networks**

**PETER VÖRSMANN**

**Chair, DLR Institute of Aerospace Systems**

**Technical University of Braunschweig**

**Managing Director of Aerodata AG**

**Tuesday, March 30, 2010**

**3:00 P.M.**

**ARMS 1109**

**Abstract**

There is a high potential to improve the degree of automation of unmanned aerial systems (UAS) by implementing adaptive flight control strategies. This is especially the case regarding autonomous operation under difficult atmospheric conditions or even system failures. Machine learning techniques enable the UAS to improve control accuracy during operation and to respond to unknown, non-linear flight conditions. Here, artificial neural networks (ANN) are used to implement a learning flight control system. This is realised with a systematic two-stage approach by firstly implementing a sustainable offline-trained basic knowledge and improving these characteristics during flight. During the automated offline-step large groups of neural control elements are trained with the required behaviour, which is derived from measured data. This phase showed that the necessary learning task can be achieved by multi-layered feedforward-networks. The training success of all networks regarding generalisation capabilities and robustness is then evaluated with statistical methods and networks are selected for online application. The online learning step is realised with a controller architecture comprising a neural network controller and a neural observer which predicts the system's dynamics and delivers the critics signal for controller training. An important element of the control strategy is to determine a consistent error signal for online training of the neural controller. This is done by back propagation of a measured error through the inverse dynamics of the observer network. In summary, the statistic analysis of the robustness of the basic knowledge as well as the implementation of a stable neural predictor into the control process proved to be central aspects of the control strategy.

**Biography**

Professor Vörsmann is Chair of the DLR Institute of Aerospace Systems at the Technical University of Braunschweig, and is Managing Director and founding partner of Aerodata AG, the world's leading manufacturer of highly sophisticated flight inspection systems.

*An informal coffee & cookie reception will be following the lecture at 4:00 p.m. in the AAE/ARMS undergraduate lounge (directly in front of ARMS 3<sup>rd</sup> floor elevators)*

COLLOQUIUM