Machine Learning for Pilot Behavior Modeling

Guest Seminar

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This talk discusses the utilization of a Hidden Markov Model (HMM) – a Machine Learning (ML) technique – in pilot behavior modeling. Special emphasis is given to the classification of flight maneuvers based on the pilot's visual scanning patterns, as these are related to her/his attention distribution and can thus act as significant indicators for task solution strategies and cognitive workload. In contrast to Markov chains, the HMM states are, by default, not directly observable, thus being estimated from the observed outputs. Simulated Instrument Flight Rules (IFR) experiments on a high fidelity fixed based flight simulator have been performed to support the feasibility evaluation of this concept. Throughout the IFR flights, gaze tracking has been employed to capture the visual scanning patterns of the pilot. This technique enabled the estimation of gaze fixation positions in space and their mapping onto flight deck elements, thus providing fixation locations and durations and a scan path structure in response to a stimulus. For the purpose of investigating the relation between flight maneuvers and their associated visual scanning patterns, a HMM structure representing the pilot's attention distribution was proposed, with hidden states being flight maneuvers, and the observations their respective pilot gaze fixations. The obtained results show the capability of the trained HMM to classify a flight maneuver based on the gaze fixations of the pilot. Findings obtained with the HMM models will further help to refine cognitive pilot model designs using modern cognitive architectures. These models can be useful in the design of future cockpits or as an objective measure in pilot training evaluation, since the HMM structure and its contents differ with respect to pilot skill level and mission type.

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