PennState College of Engineering | AEROSPACE ENGINEERING

SEMINAR SERIES

René van Paassen

Associate Professor of Aerospace Engineering
Delft University of Technology

Wednesday, December 4th

4:40-5:30 pm | 220 Hammond Building

Engineering Feeling; Human Perception of Manipulator Dynamics

ABSTRACT

In manual control of a vehicle, the "feel" of the control system plays an important role. In aircraft, the yoke or stick feel more stiff at higher speeds, providing a natural limit on the magnitude of input, in cars, the steering wheel stiffness is largely a result from torques on the wheels, enabling drivers to feel the effect of speed and road condition. The feel of a device can only be detected by active manipulation.

Experiments are described in literature that determine the accuracy by which humans can feel the device dynamics, the "just-notable-difference", (JND), i.e., the smallest change in control device dynamics that can be detected. Values reported for JND vary between 8 and 23% of the base dynamics. We hypothesise that this wide range of values is due to the conditions under which the experiments were done, control devices are typically described by their mass, damping and stiffness, and interaction between these properties affect the JND.

To better understand what causes difference in JND, a series of experiments were performed in the Human-Machine Interaction laboratory at the TU Delft. By manipulating the experiment condition, either free movement, paced movement with feedback of the resulting stick position, and paced movement with feedback of the stick force, data for a methodological analysis was obtained.

The data combine well into a single model that predicts JND in all measured points from only one JND value, the force perception JND. The model also predicts the wide range of values found in literature. We discuss several uses for the model:

- As a basis for the fidelity requirements for simulated control device dynamics in simulators
- To understand the effects of time delay and time delay compensation mechanisms on control device feel
- To evaluate the effective control feel of systems with haptic feedback

BIO

M. M. (René) van Paassen received an M.Sc. degree (cum laude) from the Delft University of Technology, Delft, The Netherlands, in 1988, and a Ph.D. in 1994, both on studies into the neuromuscular system of the pilot's arm. He theafter was a Brite/EuRam Research Fellow with the University of Kassel, Germany, where he worked on means-ends visualisation of process control dynamics, and a post-doc at the Technical University of Denmark.

René van Paassen is currently an associate professor in Aerospace Engineering at the Delft University of Technology, working on human machine interaction and aircraft simulation. His work on human-machine interaction ranges from studies of perceptual processes, haptics and haptic interfaces and human manual control to design of and interaction with complex cognitive systems. René is a senior member of IEEE, associate editor for IEEE Transactions on Human-Machine System and currently (until mid 2020) on sabbatical at Penn State University as a Fulbright Senior Scholar.

Please join us for refreshments before the seminar, at 4:15pm in the Aero Cafe (225 Hammond).