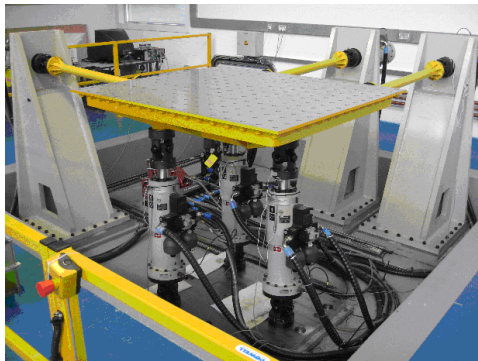### Research Project

# MODERN CONTROL FOR COMPLEX MULTI-AXIS MACHINES

Motivation

Machine systems which incorporate several interacting actuators are common. In many industries, individual closed-loop controllers are used for each actuator, and these controllers are tuned by trial and error. The aim of this project is to apply modern control techniques to such systems. These controllers give improved performance, and are tolerant to changes in the machine behaviour.

MAST

The Centre for PTMC's Multi-Axis Simulation Table (MAST) is used as a case study. This is a 6-degree-of-freedom vibration test facility, specified for payloads up to 500kg, and test frequencies up to 50Hz. The standard industrial controller (Instron 8800) is linked via a fibre-optic network to a Power PC based real-time computing platform for running Simulink auto-coded controller models.
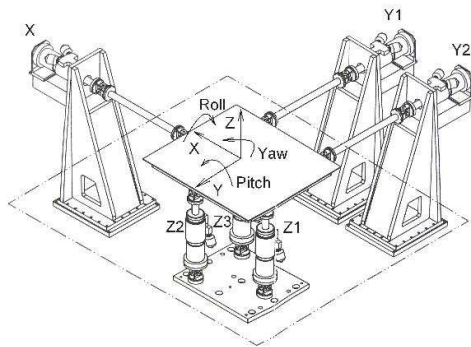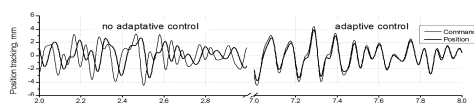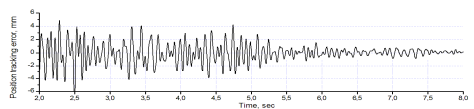
Modelling

To help understand the dynamic behaviour of the MAST, a detailed simulation model has been constructed of the control, hydraulic and mechanical systems. This uses Simulink and its multi-body simulation toolbox SimMechanics, together with an in-house hydraulic component model library.

(a) Position tracking transient of adaptive controller

(b) Position tracking error
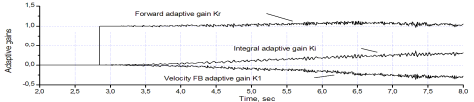
(c) Adaptive gains

Adaptive control

An enhanced version of MCS (Minimal Control Synthesis) adaptive control has been developed and implemented for position control of the MAST. Each axis has a decentralised controller which can adapt to reduce interaction between axes and to accommodate payload changes.

Future work

Other methods such as H_∞ control and gain scheduling will be implemented, assessed and compared, both for position and acceleration control.

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