Abstract

Turning Point Based Fatigue Testing Using Pneumatic Artificial Muscles as Light-Weight Actuators – Kristel Deckers

This dissertation explores the possibility of using the Pneumatic Artificial Muscle Actuators (PAM's) , common in robotics and biomechanics, in more high frequent applications such as e.g. fatigue testing. The main characteristics of the PAM's are discussed as well as their most common applications in the field of robotics and biomechanics. The case study of fatigue testing slat tracks of an A320 airplane is considered.

Since PAM's have a limited bandwidth, the conventional control algorithm (called Time Waveform Replication, or TWR) tends to diverge or converge without attaining the desired accuracy. Measurements are performed with TWR, after which a Hammerstein model of the setup is formulated. This model is used to test different control strategies before applying them on an actual slat track.

The considered control algorithms are based on the fact that only the Turning Points of a operationally measured data sequence determine the damage inflicted on the structure. A new control strategy is formulated called TPR (Turning Point Replication). The new algorithm allows for more accuracy and higher control frequencies. Moreover, an on/off algorithm is proposed to enable fast and accurate control in the turning points.

The developed algorithms are then tested on the experimental setup using PAM's as actuators. Measurements are also performed on the original hydraulic setup, to compare the new algorithms against the original TWR. This allows for a generalization of the applicability of the developed algorithms.