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Fault-Tolerant Control Study and Classification: Case Study of a Hydraulic-Press Model Simulated in Real-Time

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Abstract : Society demands more reliable manufacturing processes capable of producing high quality products in shorter production cycles. New control algorithms have been studied to satisfy this paradigm, in which Fault-Tolerant Control (FTC) plays a significant role. It is suitable to detect, isolate and adapt a system when a harmful or faulty situation appears. In this paper, a general overview about FTC characteristics are exposed; highlighting the properties a system must ensure to be considered faultless. In addition, a research to identify which are the main FTC techniques and a classification based on their characteristics is presented in two main groups: Active Fault-Tolerant Controllers (AFTCs) and Passive Fault-Tolerant Controllers (PFTCs). AFTC encompasses the techniques capable of re-configuring the process control algorithm after the fault has been detected, while PFTC comprehends the algorithms robust enough to bypass the fault without further modifications. The mentioned re-configuration requires two stages, one focused on detection, isolation and identification of the fault source and the other one in charge of re-designing the control algorithm by two approaches: fault accommodation and control re-design. From the algorithms studied, one has been selected and applied to a case study based on an industrial hydraulic-press. The developed model has been embedded under a real-time validation platform, which allows testing the FTC algorithms and analyse how the system will respond when a fault arises in similar conditions as a machine will have on factory. One AFTC approach has been picked up as the methodology the system will follow in the fault recovery process. In a first instance, the fault will be detected, isolated and identified by means of a neural network. In a second instance, the control algorithm will be re-configured to overcome the fault and continue working without human interaction.

Keywords : fault-tolerant control, electro-hydraulic actuator, fault detection and isolation, control re-design, real-time
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