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FRAGILITY ANALYSIS OF FRACTIONAL ORDER PID CONTROLLERS

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Contemporary research indicates that the fractional-order differential equations (FODE) can explain the behavior of many complex dynamical systems more accurately. Furthermore, the new developments in fractional calculus has enabled researchers to model physical phenomena by FODE. The FODE controllers have shown an impressive advantageous over the integer-order ones, e.g., the simultaneous satisfaction of all the required design specifications. In this talk, I review some of the recently published methods for the tuning of fractional-order PID controllers. These methods provide tuning rules to achieve design objectives such as phase margin, gain cross-over frequency, and zero derivative of the phase with respect to frequency at cross-over frequency; the last constraint is imposed to reach high robustness to loop gain variations. Most of these tuning methods aim at reducing the sensitivity with respect to the plant unmodeled uncertainties, however, the robustness with respect to the controller uncertainties has been largely overlooked. Hence, we analyze the robustness with respect to controller parameters, which is referred to as the fragility analysis, for the fractional-order PID-like controllers. Moreover, a new tuning method for fractional order PID controllers is proposed which results in obtaining non-fragile controllers.

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EIB 132