Reconfigurable Control of Input Affine Nonlinear Systems under Actuator Fault

This paper proposes a fault tolerant control method for input-affine nonlinear systems using a nonlinear reconfiguration block (RB). The basic idea of the method is to insert the RB between the plant and the nominal controller such that fault tolerance is achieved without re-designing the nominal controller. The role of the RB is twofold: on one hand it transforms the output of the faulty system such that its behaviour is similar to that of the nominal one from the controller’s viewpoint; on the other hand it modifies the control input to the faulty system such that the stability of the reconfigured loop is preserved. The RB is realized by a virtual actuator and a reference model. Using notions of incremental and input-to-state stability (ISS), it is shown that ISS of the closed-loop reconfigured system can be achieved by the separate design of the virtual actuator. The proposed method does not need any knowledge of the nominal controller and only assumes that the nominal closed-loop system is ISS. The method is demonstrated on a dynamic positioning system for an offshore supply vessel, where the virtual actuator is designed using backstepping.