SHORT ABSTRACT

Growing demands of reinforced reliability, survivability, safety and stringent performance requirements in complex critical systems have led to the inception of a new control paradigm, widely known as Fault Tolerant Control (FTC). Systems equipped with an FTC module are, in general, presumed to be resilient to uncertain eventualities of faults and failures. Ever since its outset, FTC has been well recognized as a promising research domain and extensive contributions have been reported so far; however largely in the context of linear dynamical systems. Given the fact that almost all physical systems existing in nature exhibit an inherent nonlinear behavior; FTC schemes for linear systems may not be fruitful when the operating regime is desired to large and precise fault tolerant control performance also becomes a critical design attribute. In addition to actuator faults/failures, the presence of unknown parametric uncertainties, modeling imperfections and external disturbances combined with structural limitations in such systems pose numerous challenges to the problem of an effective active FTC design. Therefore, this thesis resorts to an fault estimation based FTC (FE/FTC) architecture and attempts to propose some new adaptive FTC methodologies for nonlinear uncertain dynamical systems assuming the occurrence of unanticipated actuator failures. The emphasis of the design algorithms is laid on achieving an improvement in start up and post failure transients without yielding to any decrement in input performance (quantified in terms of total variation and energy of input signal). Therefore in this thesis, such ambitious objectives are attained through an amalgamation of robust control ideas with the inherent online learning capabilities of adaptive control. The proposed control laws exhibit promising fault tolerant performance, affirm all theoretical propositions and qualifies well for applicability to practical systems.