Data-Driven Robust Receding Horizon Fault Estimation

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This talk presents a data-driven receding horizon fault estimation method for unknown linear time invariant systems, with enhanced robustness to stochastic identification errors. State-of-the-art methods construct fault estimators with identified state-space models or Markov parameters, but they do not compensate for identification errors. Motivated by this issue, we first propose a receding horizon fault estimator parameterized by predictor Markov parameters. It gives (asymptotically) unbiased fault estimates as long as the subsystem from faults to outputs has no unstable transmission zeros. When the identified Markov parameters are used to construct the above fault estimator, identification errors appear as model uncertainty multiplied with unknown fault signals and online data. Then, a mixed $\mathcal{H}_2/\mathcal{H}_\infty$ problem is formulated for the offline robust design that regards online data as unknown. To exploit the available online data, an online $\mathcal{H}_2/\mathcal{H}_\infty$ problem is also formulated. It can further reduce estimation errors when the online data have large amplitudes, at the cost of heavier computational burden. Based on geometrical interpretation of the offline and online optimization problems, systematic methods are given to tune the user-defined parameters therein. Simulation examples illustrate the benefits of our proposed methods compared against a recently proposed method in literature.