IFAC World Congress Tutorial (July 8, 2017) Analysis and Design of Model Based Fault Diagnosis Systems for Large Scale Models

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Abstract

Real applications are often complex and model-based techniques for diagnosis are therefore often faced with a general, large-scale, and non-linear differential-algebraic model, possibly in high level languages like Simulink or Modelica consisting of hundreds or thousands of equations. Such complex models often require specialized techniques for specific classes of systems. One successful way to manage the complexity is to utilize the model structure using graph based algorithms. Structural analysis has proven to be a powerful tool for generating detection signals and early determination of fault isolability properties.

Main themes

1. Formally introduce structural models and fundamental diagnosis definitions
2. Derive algorithms for analysis of models and diagnosis systems
   - Fundamental graph-theoretical tools, e.g., Dulmage-Mendelsohn decomposition of bi-partite graphs
   - Fault isolability of a model
   - Fault isolability of a diagnosis system
   - Find sensor locations
3. Algorithms for design of residual generators
   - Find minimal submodels with redundancy
   - Generating residuals based on submodels with redundancy
4. Interactive Matlab sessions
   - Analysis and design for a provided use-case;
   - Analysis and design on own laptop (optional)
   - Illustration on an industrial sized example

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faultdiagnosistoolbox.github.io