# CPS Small: Fault Diagnosis and Prognosis in a Network of Embedded Systems in Automotive Vehicles

NSF Grant: 0931956

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- Research Objectives
  - Diagnosis of physical system, electronic control unit and network faults
  - Fault prognosis to predict the remaining useful life (RUL) of physical components based on the inferred failing components and their tracked paths of degradation
- Technical Approach
  - Dependency model generation for failure modes, effects and criticality analysis and test point optimization (Simulink/PSAT + CANoe )
  - Coupled factorial hidden Markov models + Lagrangian relaxation/Gauss-Seidel + Viterbi for online inference of *multiple*, *coupled and intermittent* faults
    - Dynamic multiple fault diagnosis (DMFD) with *delayed* observations
    - Dynamic coupled fault diagnosis
    - Dynamic fusion of classifiers
    - Dynamic set covering
  - Prognosis in *coupled* systems based on failure time, parametric and dynamic signal data
    - Survival functions of test outcomes via Cox proportional hazards model
    - Infer component survival functions via *soft* DMFD and estimate RUL
- Target System: Regenerative Braking in Hybrid Electric Vehicles
- Benefits
  - Reduced mean time to repair
  - Increased vehicle availability
  - Improved customer satisfaction
  - Reduced cost of service and warranty costs