Dynamic Multiple Fault Diagnosis (DMFD): Mathematical Formulations and Solution Techniques

DMFD problem:
- Multiple faults occurring over time
- Imperfect test outcomes manifest as missed detections and false alarms
  - Unreliable sensors
  - Electromagnetic interference

Solution approach: Primal-dual decomposition
- Separable problems at lower level
- Coordination via multipliers
- Distributed implementation

Two-level coordinated solution framework

DMFD formulations:
- Several partially-observed factorial hidden Markov models (FHMMs)
- Perfectly-observed coupled Markov decision processes
- Intractable NP-hard combinatorial optimization problems

Update Lagrange multipliers using Subgradient method

Solve subproblem 1 using binary Viterbi algorithm
- Real-time implementable
- High diagnostic accuracy
- Small duality gap

Solve subproblem m using binary Viterbi algorithm