UNIVERSITY OF MINNESOTA
Driven to Discover℠

Performance Driven Agglomerative Clustering Software

Finds Optimal System Decomposition using Greedy Algorithm

Performance Driven Agglomerative Clustering (PDAC) is a simulation optimization software package that finds optimal system decomposition. The method uses data (i.e., from a large scale chemical plant) to generate a system decomposition for which a distributed statistical monitoring method's performance in detecting a set of faults is near optimal. PDAC borrows search strategies from agglomerative clustering to generate a set of candidate system decompositions and simulates the monitoring performance of the distributed method for different candidate decompositions using process data. The candidate decomposition with the best monitoring performance is used as output. PDAC is the only system decomposition method for distributed statistical monitoring that:

- finds both an optimal allocation of the measured variables into the subsystems as well as the optimal number of subsystems,
- directly optimizes the performance of a distributed method by simulating it as a whole to find a near optimal decomposition,
- uses the greedy search of clustering algorithms to solve simulation optimization problems.

Uses Multivariate Statistical Process in Partitioned Systems

Conventional multivariate statistical process monitoring methods (e.g., Principal Component Analysis) perform poorly in detecting faults in large systems with a large number of measured variables but where most faults affect only a small subset of the measured variables. Partitioning the system and implementing a multivariate statistical process monitoring method in a distributed manner improves monitoring performance, so a solution to this problem is to implement statistical monitoring methods in a distributed configuration. In this configuration, a plant's measurements are first decomposed/partitioned into subsystems. Then a statistical monitoring method is implemented in each subsystem and the monitoring results are fused using a consensus strategy to determine if a fault is affecting the plant. By adopting this strategy, PDAC outperforms other system decomposition methods. The PDAC software package is currently implemented in MATLAB.

BENEFITS AND FEATURES:

- Simulation optimization software
- Finds optimal system decomposition
- Borrows search strategies from agglomerative clustering algorithms
- Finds both an optimal allocation of the measured variables into the subsystems as well as the optimal number of subsystems
- Directly optimizes distributed method performance by simulating it as a whole
- Outperforms other system decomposition methods
- Software package currently implemented in MATLAB

APPLICATIONS:

Technology ID
20180385

Category
Express License
Software & IT/Algorithms
Software & IT/Simulation & Modeling

Learn more

- Simulation optimization software
- Finding optimal system decomposition
- Chemical plants

Phase of Development – software available for commercial and non-profit research.

Researchers

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Publications

System Decomposition for Distributed Multivariate Statistical Process Monitoring by Performance Driven Agglomerative Clustering

Industrial & Engineering Chemistry Research, May 30, 2018

Optimal Feature Selection for Distributed Data-Driven Process Monitoring.

Industrial & Engineering Chemistry Research , 2019

Generating optimal overlapping subsystems for distributed statistical fault detection subject to constraints.

Journal of Process Control, 2019

System Decomposition for Distributed Data-Driven Process Monitoring.

Ph.D. thesis. University of Minnesota, Khatib, S., 2020.