Multiple Root-Cause Alarm Flood Classification with Weighted Dissimilarity Indices

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Modern industrial facilities and processes have been becoming increasingly complex since a few decades ago. Massive numbers of sensors, actuators, and controllers can inevitably experience failures and induce alarm floods. Efficient fault detection and isolation (FDI) for these components based on analytical models and historical process/alarm data have attracted extensive research interests. Existing studies on root cause analysis are mostly restricted to the scenario that an alarm flood is caused by a single fault, which can be identified by machine learning and pattern matching algorithms. In real industrial processes, it is not rare that some units fail simultaneously, or more than one fault occurs within a short period of time. Owing to physical inter-connections and coupled material/information flows, a faulty component can sometimes cause its neighbor components to fail. Early isolation of *all* root causes that induce an alarm flood is an important topic. It not only allows field operators to respond quickly to tackle all malfunctioning units, but also is a core requirement for advanced alarm management systems.

Motivated by the deficiency identified above, this paper proposes a pattern matching algorithm to achieve multiple root-cause alarm flood classification with weighted dissimilarity indices. For each labeled subset of historical data, a binary signature vector is firstly extracted as the alarm flood template; then a weighting factor is assigned to each unique tag to enhance the importance of relevant alarms and deemphasize irreverent ones. For alarm floods with multiple root causes, a *predict-update* strategy is adopted to fuse the information in historical data. Alarm flood classification is then achieved by comparing the weighted dissimilarity scores of an ongoing alarm flood with each template vector. The effectiveness of the proposed method is verified with simulated data from a Vinyl Acetate Monomer (VAM) plant model.

Keywords: Alarm Flood Template, Dissimilarity Index, Multiple Root Causes, Pattern Matching