Method for generating a minimum set of analytical redundancy relations for the diagnosis of systems

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A novel concept of Minimal Set of Analytical Redundancy Relation (ARRs) and an efficient method for its calculation for application to system diagnosis is developed.

Starting with the complete set of ARRs for a system and the resulting Fault Signature Matrix for any number of considered faults, there can be smaller sets of ARRs which achieve the same level of detection and isolation as the complete set of ARRs. The derivation of minimal set of ARRs can be formulated as a 0-1 integer programming problem and consequently, an efficient branch-and-bound method for its solution is presented. Instead of simple measure of the cardinality of the subset of ARRs, the concept of minimality can be extended to the real computational cost of evaluating ARRs for diagnosis. In fact, many practical systems might involve some components with nonlinear functions which are more costly and/or less precise for computation than other components of the system with simpler function. For such cases, once the ARRs of the system are derived, a careful analysis can reveal those ARRs which involve such costly and/or less precise components. The calculation of minimal set of ARRs can then be performed by assigning a computation and/or precision cost to each ARR and the result will be a set of ARRs with minimal cost.

The method can be applied to all the systems involving some components with nonlinear functions which are more costly and/or less precise for computation than other components of the system with simpler function.

ARR, analytical redundancy relation, system diagnosis

1) Procedimento per la derivazione di un insieme minimo di relazioni di ridondanza analitica per la diagnosi di sistemi
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