

SYMPOSIUM ON COMMERCIAL SPACEFLIGHT SAFETY ISSUES (D6)  
Commercial Space Flight Safety and Emerging Issues (1)

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CONJUNCTION DETECTION AND SERIES CLUSTERING OF TELEMETRY DATA FROM  
SPACECRAFT IN ORBIT

**Abstract**

In order to analysis relationship of abnormal changes taking place at different data sequences among multidimensional telemetry data flows, there are some conventional approaches which are based on the correlation analysis and regression analysis of stationary series and mainly focus on exploring the connection among the different data series value. Maybe, some quantitative or qualitative analysis methods, which are based on data mining and knowledge discovery technologies, are usable to explore the inherent regularity or characteristic information, and some fault detection and diagnosis algorithms, which are based on the threshold monitoring, may be directly realized from telemetry data. But, there were few studies discussed the results about inherent relevance between the homologous data abnormal changes in a multidimensional telemetry data flow, which may give us some valuable inspiration where the faults arise and which kind of faults result in abnormal changes in part of the multidimensional telemetry data flow. Because of the reasons stated above, some practical problems, such as clustering of abnormality changes in telemetry data flow and monitoring of health states and so on, are combined into consideration and new clustering methods oriented at process abnormal changes are proposed.

In fact, to explore the conjunction of abnormal changes among different processes is a key and challenging technique problem in processes monitoring, in faults analysis, and in faults location. In order to solve this key problem stated above, two kinds of correlation detection function are ingeniously appropriated in this paper. Based on the correlation detection functions, a large number of different processes are clustered. After clustering these series, the approaches are proposed to distinguish different anomalies in a large-scale complex system, which relies on whether the changes cause the same cause or not. Then a feasible technical approach is provided for us to discover and to judge causes of faults in the system operation processes. Specifically, a set of relevance detection index are established, which are applicable to clear impurity band and to mend the missing telemetry data sequence. The multi-dimensional clustering method of telemetry data are used and several series of are existed. Analysis of the simulation result are used to verify the availability of this method and algorithm; an indication series is used to symbolize the abnormal change in sampling series, two kinds of conjunction test indices are constructed to measure the conjunction degrees, which rely on the indication series of multidimensional synchronization sampling series and the abnormal change percentage series of multidimensional asynchronous sampling series separately. What is more, these conjunction-test indices are successfully used to set up the clustering algorithms of abnormal changes in multidimensional series. Some Monte Carlo results show that algorithms given in this paper are efficient. The idea and technological methods of this paper are helpful

for us to get viable approaches to analyze abnormal changes and to diagnose faults in large-scale dynamic system.