Space Telemetry Anomaly Detection Based On Statistical PCA Algorithm

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Abstract : The crucial concern of satellite operations is to ensure the health and safety of satellites. The worst case in this perspective is probably the loss of a mission but the more common interruption of satellite functionality can result in compromised mission objectives. All the data acquiring from the spacecraft are known as Telemetry (TM), which contains the wealth information related to the health of all its subsystems. Each single item of information is contained in a telemetry parameter, which represents a time-variant property (i.e. a status or a measurement) to be checked. As a consequence, there is a continuous improvement of TM monitoring systems in order to reduce the time required to respond to changes in a satellite's state of health. A fast conception of the current state of the satellite is thus very important in order to respond to occurring failures. Statistical multivariate latent techniques are one of the vital learning tools that are used to tackle the aforementioned problem coherently. Information extraction from such rich data sources using advanced statistical methodologies is a challenging task due to the massive volume of data. To solve this problem, in this paper, we present a proposed unsupervised learning algorithm based on Principle Component Analysis (PCA) technique. The algorithm is particularly applied on an actual remote sensing spacecraft. Data from the Attitude Determination and Control System (ADCS) was acquired under two operation conditions: normal and faulty states. The models were built and tested under these conditions and the results shows that the algorithm could successfully differentiate between these operations conditions. Furthermore, the algorithm provides competent information in prediction as well as adding more insight and physical interpretation to the ADCS operation.