"Profile monitoring via sensor fusion: the use of PCA methods for multi-channel data"

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Abstract: Continuous advances of sensor technology and real-time computational capability are leading to data-rich environments to improve industrial automation and machine intelligence. When multiple signals are acquired from different sources (i.e. multi-channel signal data), two main issues must be faced: (i) the reduction of data dimensionality to make the overall signal analysis system efficient and actually applicable in industrial environments, and (ii) the fusion of all the sensor outputs to achieve a better comprehension of the process. In this frame, multi-way principal component analysis (PCA) represents a multivariate technique to perform both the tasks. The paper investigates two main multi-way extensions of the traditional PCA to deal with multi-channel signals, one based on unfolding the original data-set, and one based on multi-linear analysis of data in their tensorial form. The approaches proposed for data modelling are combined with appropriate control charting to achieve multi-channel profile data monitoring. The developed methodologies are demonstrated with both simulated and real data. The real data come from an industrial sensor fusion application in waterjet cutting, where different signals are monitored to detect faults affecting the most critical machine components.

Bibliografia

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