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A novel multi-set data analysis approach for enhancing industrial process understanding and troubleshooting

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Nowadays, in order to guarantee and preserve the high quality of their products, most manufacturing companies design monitoring schemes which allow abnormal events to be quickly, easily and efficiently recognised and their possible root causes to be correctly identified. Traditionally, these monitoring schemes are constructed calibrating a so-called *in-control* model on data collected uniquely under Normal Operating Conditions (NOC), and are subsequently utilised to assess future incoming measurements. Once an *out-of-control* signal is spotted, the measured variables mostly affected by the fault can be distinguished by means of tools like the so-called contribution plots.
Process understanding and troubleshooting, though, can also be regarded from a slightly different perspective. Imagine, for example, that the same variables are registered for the same process both during NOC and while a failure is ongoing, yielding two different data blocks sharing, in this case, the variable dimension. If one assumes that the variation characteristic only of the failure-related dataset inherently contains information on the deviation from NOC, then exploring such variation to find out what is causing the fault in production could be alternatively achieved by *fusing* and analysing the two aforementioned data blocks as a concatenated multi-set structure. This way, their underlying common and distinctive sources of variability could be unravelled and investigated separately so as to get clearer insights into the reasons behind the failure itself. In this presentation, a novel methodology to tackle these two tasks will be described and tested in a case-study involving a real-world industrial process.

Keywords

multi-set data analysis, industrial process understanding and troubleshooting, common and distinctive components

Primary authors: VITALE, Raffaele (University of Lille); Mr DE NOORD, Onno E. (Advanced Data Analysis Consultancy); Dr WESTERHUIS, Johan A. (University of Amsterdam); Prof. SMILDE, Age K. (University of Amsterdam); Prof. FERRER, Alberto (Technical University of Valencia)

Presenter: VITALE, Raffaele (University of Lille)

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