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## Multivariate alarm configuration strategy in industrial plants

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Alarms are used in industrial plants to remind operators of abnormality so that they can take proper actions to solve the problems to remove or alleviate the symptoms. Traditionally, alarms are triggered according to comparison with thresholds configured on specific process variables. To reduce the influence of noise and instability, techniques such as filtering, dead bands, and time delays are used to avoid false and missed alarms as much as possible, whereby keeping the detection delay in an acceptable range. All the above techniques are based on the idea of univariate alarm strategy. However, due to the relationship between variables, alarms should ideally be designed in a multivariate framework, i.e., as combined indices generated by a set of variables, including both continuous process variables and binary variables. For this purpose, the similarity or extended correlation between variables needs to be defined and therefore statistical techniques such as principal components analysis can be employed for the index generation and visualization tools such as alarm similarity color map (ASCM) can be used for intuitive analysis. In addition, especially considering of dynamic factors, there may be evident causality between alarms, leading to parent-child alarms; thus various causality analysis techniques can be utilized to build topology and find root causes. These techniques include data-based analysis and formulized knowledge description and discovery. The former includes Granger causality, transfer entropy, and partial directed coherence, and the latter can be ontology models and their reasoning. Some case studies are shown to illustrate the proposed techniques.

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## Natural language based intelligent robot to advance industrial automation

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Automation had started in the late 18th century with mechanization of textile industry, and initiated the first industrial revolution. It then continued, and started the second industrial revolution in early 20th century when Henry Ford mastered the moving assembly line and ushered in the age of mass production. The first two industrial revolutions made people richer and more urban. The biggest benefit of automation is that it saves labor. However, it is also usedto save energy & materials and to improve quality, accuracy and precision. Now a third revolution is under way. Manufacturing is going digital. And what would be the next? We believe it will be Intelligent Agent based robots that will take industrial automation to the next level. Such robots will also communicate more naturally with human and machine. The dominant mechanism for natural communication is Natural Language. This talk will focus on the key issues of robots to drive industrial / manufacturing automation. It will discuss specifically NLP (Natural Language Processing) Algorithms and Intelligent Agent (IA) - the two core components of future automation. NLP is very important for the best HCI (Human Computer Interaction): Natural language based interaction, in general, is the most preferred communication with man as well as machine. Clearly understanding user's input by IA is also the key to take necessary actions. The core to NLP is a "Semantic Engine" that can understand the semantics, and is critical for any complex NLP based applications using. We will discuss a Semantic Engine using Brain-Like Approach (SEBLA) and associated NLP & Natural Language Understanding (NLU) based approach to address the key problems of intelligent robot based automation. SEBLA based NLU (SEBLA-NLU) resembles human Brain-Like and Brain-Inspired algorithms and hence is good at dealing with natural language based interactions. In fact, SEBLA and IA are also very critical to solve most Big Data problems,especially when data is dominated by text. Our proposed SEBLA and IA base solution would make it much easier to effectively use robots by non-technical, semiliterate, illiterate as well as by technical people.

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