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THE USE OF WAVELETS FEATURE EXTRACTION AND SELF ORGANIZING MAPS FOR FAULT DIAGNOSIS

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Abstract. *Nowadays, model-based fault diagnosis is restricted to a-priory knowledge of the plant model where in the case of a model-free strategy it is necessary to have enough information in terms of frequency response of the observed plant. This approach presents the advantage of using several strategies for feature extraction and classification to achieve pattern recognition based upon nonlinear behaviour. For instance, Principal Component Analysis, wavelets, time frequency distributions and partial model-build parameters (like ARMAX) are techniques feasible to extract key characteristics from data either in terms of time series or multidimensional clustering. However, these may not be suitable for every data analysis in terms of unknown scenarios; therefore it is needed to combine some of them to achieve a feasible classification. In that respect, the use of non supervised neural networks like ARTMAP or Self Organizing Maps (SOM) as powerful classifiers to organize data in accurate terms as post-processing techniques becomes suitable in specific cases, where the most common characteristics are hard nonlinearities and a great variation of frequencies. In that respect, a preprocessing stage is needed in order to decompose the information on suitable patterns to be classified, techniques like wavelets or dynamic principal component analysis are relevant. Based upon these two issues, two strategies are followed; a common continuous wavelet transform is used as pre-processing stage and SOM for post-processing the data. Both have been chosen in terms of partial linear model representation and the related classification, where some important restrictions are related to inherent online characteristics and time variances. An important issue to be taken into account is sampling to avoid quantization at fault diagnosis algorithm as an important parameter. A benchmark example with two typical faults is reviewed and implemented in order to highlight the benefits of this novel strategy. Results of this evaluation are presented in terms of several simulated experiments considering fault and fault-free scenarios.*

Keywords: Wavelets, Self-Organizing maps, Fault diagnosis

1. **Introduction.** Nowadays, fault diagnosis is established in two approaches, model-based and model-free. This paper focuses on the later. The challenge is to classify faults at early stages with an accurate response. In this case, model is not available neither fault-free nor fault presence. The objective is to classify faults based upon system response and the related signal analysis in terms of dilation and shift decomposition as stated in wavelets. In order to accomplish classification, a powerful nonlinear neural network is pursued like self-organizing maps. Several strategies have been studied in terms of feature extraction using wavelets networks. For instance, [1] presents a wavelet packet feature