HIGH RESOLUTION LOAD CLASSIFICATION BY MEANS OF A NEURAL NETWORK TECHNIQUE

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Abstract

Certain electronics applications require direct characterization of impedances. This is a typical problem in power converter design, specially characterizing time variant loads in order to know certain amount of information about the system to get an efficient power management.

Depending on how much information is needed for the application, two approaches have been traditionally used. They are the exact black-box linear modelling and the energetic based description. The first is able to exactly describe the behaviour of linear impedances. For most applications such amount of information is not needed and makes difficult to relate physical phenomena and the electrical parameters of the model. The second approach involves severe information lost and difficult load classification because different loads can be described with the same energetic model.

In this paper a mixture of those methods is proposed. It is based on an flexible approach which is able to classify load patterns with controllable precision. Moreover, it is able to change pattern discrimination capability to noise immunity relaxing data acquisition requirements. When smaller precision is required, identification can be achieved in a robust way within a noisy environment. It has been chosen the domestic induction heating scenario with the inductor-pot couple being the unknown load. The power stage used for this study is a series-resonant half-bridge inverter.

The method comprises several stages. Firstly, frequency behaviour of load is analyzed by means of spectrum estimation of voltage and current across the load. To get a complete measurement over the entire frequency range, spread spectrum excitation is required. The article analyzes possible useful solutions widely used in the power electronics field. Secondly, characteristic parameters extraction is computed. As a result, sub-band modelling of the admittance module is carried out and a definite amount of parameters are used in the classification process.

This stage is performed in a simple neural network which enables noise and measurement distortion influence reduction. The trade-off between the number of sub-bands employed for analysis, networks complexity, noise immunity and precision attained is analyzed. The method also permits flexible interpretation of results by means of network outputs definition being used to evaluate load characteristics. Moreover, measurement calibration is not needed because it is carried out at network training taking in advantage neural networks benefits.

The paper presents previous experimental results which show examples about load identification necessity in this context and conclusions of theoretical studies obtained in a Matlab-Simulink simulation test bench. From results it can be concluded that precise classification of load could be achieved in presence of low signal to noise ratios and high quantization distortion.

Bibliography