

On the Use of the “Bagplot” Representation for a Sensitivity Analysis on the Effects of Bearing Dynamic Stiffness Variations on the Vibrations of a Steam Turbine

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ABSTRACT

The present paper is aimed to introduce the bagplot, which is a statistical recent technique able to give a concise evaluation of bivariate data and of their distribution, as an analysis tool for vibration data specially suitable for rotor dynamics. The harmonic components of vibrations are complex numbers and a polar plane is usually employed to define acceptance regions that can be compared with the bivariate data cloud. Anyway, since it is rather difficult to evaluate the actual statistical distribution of the data, a normal distribution is assumed, using mean values and standard deviations of the data. A better evaluation of the obtained complex data distribution can be obtained by means of the bagplot. In the first part of the paper the theory used to define the bagplot for a general bivariate data set is presented.

In the second part of the paper, an application is shown. This case study deals with a sensitivity analysis on the effects of bearing coefficient mistuning on the vibrational behaviour of a large rotating machine in which a crack shaft is present. In fact, one of the most common problem in modelling of rotating machines is the evaluation of linearized dynamic coefficients of the bearings. Theoretical and numerical tools are available in the application field. However, uncertainties in the evaluation of the bearing clearance and discrepancies between the ideal and actual alignment of the machine can cause significant errors in the evaluation of the dynamic stiffness of journal bearings. Owing to these uncertainties, the bearing coefficients can range inside wide confidence regions. Moreover, errors in dynamic coefficient evaluation can override the effect of malfunctions, on the vibrational behaviour. This fact should be taken in account in the model tuning and in the diagnostic procedures. The crack was chosen in this case since its presence generates a several harmonic components of which almost 1X, 2X and 3X should be taken into account. The analysis of the large amount of the simulated data relative to the effect of the crack is made easier by means of the bagplot use.