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# Nonlinear Cointegration as a Combinatorial Optimisation Problem

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Recent papers by the authors have explored the possibility of furthering SHM research by adopting techniques from time series analysis carried out in the context of econometrics. In particular, the method of cointegration shows great promise as a means of removing environmental and operational effects from SHM feature data. Essentially, cointegration allows the combination of multiple features in such a way as to purge the combination of any common trends e.g. variations due to changing environmental temperature. One major limitation of the established cointegration theory is that it is a linear one and does not accommodate the possibility that a nonlinear combination of variates may be needed in order to completely remove environmental and/or operational effects. In a previous paper, the authors made use of an evolutionary algorithm in order to create a nonlinear combination of variates. This algorithm was based on the idea that all possible multinomials in the variates might appear in a parametrised sum. In situations with many features, the previous approach is likely to run into difficulties due to the fact that the number of candidate terms grows explosively with the number of features. In the current paper, an alternative approach is taken whereby the optimisation procedure is used to select an optimal subset of the candidate terms, with the parameters for combination then determined by exploiting linear cointegration theory. The application of the method is demonstrated via system simulation of data.

**Ключевые слова:**

## Содержание.

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