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# PROPER ORTHOGONAL DECOMPOSITION AND ITS APPLICATIONS – PART I: THEORY

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### Abstract

In view of the increasing popularity of the application of proper orthogonal decomposition (POD) methods in engineering fields and the loose description of connections among the POD methods, the purpose of this paper is to give a summary of the POD methods and to show the connections among these methods. Firstly, the derivation and the performance of the three POD methods: Karhunen – Loève decomposition (KLD), principal component analysis (PCA), and singular value decomposition (SVD) are summarized, then the equivalence problem is discussed via a theoretical comparison among the three methods. The equivalence of the matrices for processing, the objective functions, the optimal basis vectors, the mean-square errors, and the asymptotic connections of the three methods are demonstrated and proved when the methods are used to handle the POD of discrete random vectors.



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