



## *Dimension Reduction Estimation: Can Linear Methods Solve Nonlinear Problems*

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**Abstract:** In regression modelling, data visualization plays an important role and some useful tools have been developed such as residual plots when we do not have specific model structure at hand. In low-dimensional paradigms, these tools are very useful to get ideas about underlying regression models. However, in high-dimensional paradigms, residual plots can only get the profiles of the whole picture of underlying models and the information may mislead further modelling. Therefore, if we explore and identify dimension reduction structure first and then the further modelling can be proceeded such that the classical visualization tools can be satisfactorily performed. In this lecture, the sufficient dimension reduction concept, particularly the dimension reduction subspace called the central subspace will be first briefly introduced. After that, we introduce two approaches to identify and estimate the central subspace, or equivalently, the base vectors of the subspace. Interestingly we will show that under certain regularity conditions, the ordinary least squares method (OLS) that is for linear regression models can be well applied to identify one of the base vectors. It is particularly useful when underlying model has only one such vector. The examples of models include some nonlinear and even semiparametric models such as generalized linear models, transformation models and single-index models. Further, another moment-based method called the principal Hessian direction (pHd) is introduced which can identify and estimate more than one base vector. Neither needs nonlinear or nonparametric estimation procedure even the underlying models are nonlinear and semiparametric.

**Biographical Sketch:** Dr. Zhu is the structural chair professor and the head of Department of Mathematics at Hong Kong Baptist University, Hong Kong. His research interests include semiparametric and nonparametric statistics, high-dimensional data analysis, applications of empirical process theory to statistics and econometrics. He has published more than 250 papers in a wide variety of peer-reviewed journals. His monographs include "Nonparametric Monte Carlo Tests and Their Applications", "Nonparametric Monte Carlo Test with Applications" and "Empirical Likelihood in Nonparametric and Semiparametric Models". Dr. Zhu presides 35 funds with the cumulative amount of subsidy more than 10 million Hong Kong dollars. He has received many awards and honors, including the Humbolt Research Award from Germany and the State Natural Science Award of China (Class II) (the second awardee in Statistics in China). Dr. Zhu is an elected fellow of ASA and IMS, an elected member of ISI. He is also an honorary chair professor/distinguished adjunct professor for various universities, including a Chang-Jiang Chair Professor at Renmin University of China. He serves as a member in the physical science panel of the University Grants Council of Hong Kong.

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