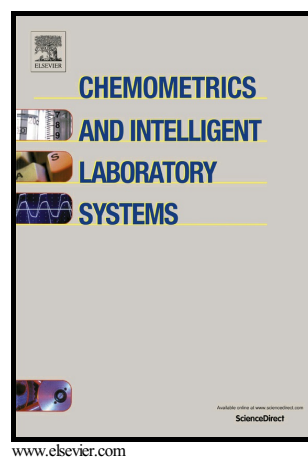


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# Probabilistic learning of partial least squares regression model: Theory and industrial applications

Junhua Zheng, Zhihuan Song, Zhiqiang Ge\*

*State Key Laboratory of Industrial Control Technology, Institute of Industrial Process Control, College of Control Science and Engineering, Zhejiang University, Hangzhou, China, 310027*

\*Corresponding author: gezhiqiang@zju.edu.cn

## Abstract

This paper formulates a probabilistic form of the widely used Partial Least Squares (PLS) model for regression modeling and application in industrial processes. Different from the existing probabilistic Principal Component Analysis/Principal Component Regression models, two types of latent variables are introduced into the probabilistic PLS model structure. For training and parameter learning of the probabilistic PLS model, the Bayes rule is applied and an efficient Expectation-Maximization algorithm is designed. Furthermore, in order to describe more complicated processes, the single probabilistic PLS model is extended to the mixture form under a similar probabilistic modeling framework. Two industrial case studies are provided as examples of the application of soft sensors constructed based on the new developed models.

**Keywords:** Probabilistic partial least squares; Regression modeling; Expectation-maximization; Mixture probabilistic model.

## 1. Introduction

With the wide used of the distributed control system during the past several decades, a large amount of

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