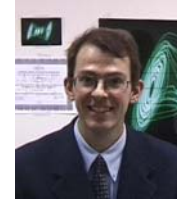

Support Vector Machines and Kernel Based Learning

Johan Suykens

Katholieke Universiteit Leuven, Leuven (Heverlee), Belgium

<http://www.esat.kuleuven.ac.be/sista/members/suykens.html>



This tutorial presents an introduction to support vector machines and kernel based methods in supervised, unsupervised and semi-supervised learning. It includes kernel based learning for regression, classification, principal component analysis, spectral clustering, canonical correlation analysis, data visualization and others. Primal and dual model representations, respectively in terms of feature maps and positive definite kernel functions, are discussed for support vector machine and least squares support vector machine approaches. Starting from first principles it is explained how gradually more sophisticated kernel machines can be designed in a systematic fashion. The theory and algorithms are illustrated by several examples in the areas of nonlinear system identification, pattern recognition, biomedicine and bioinformatics.

General outline:

Part I

- neural networks and support vector machines, feature map and kernel, primal and dual problem
- classification, regression, convex problem, robustness, sparseness
- different approaches in kernel based learning, least squares support vector machines as core models
- kernel principal component analysis, large scale fixed-size method, nonlinear modeling

Part II

- weighted kernel PCA and spectral clustering, semi-supervised learning, kernel canonical correlation analysis
- model selection, structure detection, kernel design, incorporation of constraints and prior knowledge
- kernel maps with a reference point, dimensionality reduction and data visualization

.....
Johan Suykens is currently a Professor with K.U. Leuven, ESAT-SCD, Belgium. His research interests are mainly in the areas of the theory and application of neural networks and nonlinear systems. He is author of the books "Artificial Neural Networks for Modelling and Control of Non-linear Systems" (Kluwer Academic Publishers) and "Least Squares Support Vector Machines" (World Scientific), co-author of the book "Cellular Neural Networks, Multi-Scroll Chaos and Synchronization" (World Scientific) and editor of the books "Nonlinear Modeling: Advanced Black-Box Techniques" (Kluwer Academic Publishers) and "Advances in Learning Theory: Methods, Models and Applications" (IOS Press). In 1998 he organized an International Workshop on Nonlinear Modelling with Time-series Prediction Competition. He has served as associate editor for the IEEE Transactions on Circuits and Systems-I (1997-1999) and since 1998 he is serving as associate editor for the IEEE Transactions on Neural Networks. He received an IEEE Signal Processing Society 1999 Best Paper (Senior) Award and several Best Paper Awards at International Conferences. He is a recipient of the International Neural Networks Society INNS 2000 Young Investigator Award for significant contributions in the field of neural networks. He has served as a Director and Organizer of the NATO Advanced Study Institute on Learning Theory and Practice (Leuven 2002) and as a program co-chair for the International Joint Conference on Neural Networks 2004 and the International Symposium on Nonlinear Theory and its Applications 2005.