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# Search Techniques in Intelligent Classification Systems

 Springer

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*To my wife Liudmila and children Vladislav  
and Irina for their love and support*



# Preface

Modern intelligent classification systems are characterized with an insufficient performance in the case of large databases. Various search techniques have been proposed to speedup the search procedures for such tasks as image analysis, speech recognition, etc. However, the features, the classifiers, and the structural scheme of decision-making are individually designed for each specific domain.

The purpose of this monograph is to describe the unified methodology for the classification of audiovisual data. By using probability theory, we present novel asymptotically minimax criteria, suitable for practical applications in imaging and data analysis. We highlight several well-known special cases, e.g., the probabilistic neural network and the nearest neighbor rule with the Jensen-Shannon divergence.

Our goal is to provide a guide for students and young researchers, who are interested in both theoretical and practical aspects of the classifier design in intelligent systems, which suffer from the small-sample size problem. We assume only minimal familiarity of the reader with a course in probability theory. This monograph can be used not only as a guide for independent study but also as a supplementary material for a technically oriented graduate course in intelligent systems and data mining.

Nizhny Novgorod, Russia  
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Andrey V. Savchenko





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# Acronyms

AR	Autoregression model
ASR	Automatic speech recognition
CNN	Convolutional neural network
DNN	Deep neural network
FAR	False-accept rate
GMM	Gaussian mixture model
HMM	Hidden Markov model
HOG	Histograms of oriented gradients
HT-PNN	Homogeneity testing probabilistic neural network
i.i.d.	Independent identically distributed
LBP	Local binary patterns
LPC	Linear prediction coding
LSTM	Long short-term memory
MFCC	Mel-frequency cepstral coefficients
MLS	Maximum likelihood search
NN	Nearest neighbor
PCA	Principal components analysis
PNN	Probabilistic neural network
PHOG	Pyramid histogram of oriented gradients
PSD	Power spectral density
SIFT	Scale invariant feature transform
SNR	Signal-to-noise ratio
SVM	Support vector machine
TWD	Three-way decisions