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Abstracts of Plenary and Invited Lectures

Section:

16. Applications

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Strategies for Seeing

In order to develop algorithms for machine vision one must adapt the strategy for seeing to the type of scenery that is expected as input to the sensor, and also to what is the purpose of the vision machine at hand. Since both the type of scenery and the purpose can vary from case to case it will be necessary to develop many strategies and we shall present a few.
The crucial step is the mathematical representation of the scenery and its variability. We shall create pattern theoretic representations that describe the scenes in algebraic terms: via concepts like generators, similarity groups, configurations, images and patterns, and then express their variability through a probability measure on the resulting algebraic structure. The physics of the sensor will be given in terms of a likelihood function that relates the true (but unknown) scene to the output of the sensor. We can then derive the posterior probability measure of the scene, given the observation, from Bayes' theorem.
While this is possible in theory, a major obstacle to practical implementation is the fact that the posterior measures live on structures of extremely high dimension and are seldom of analytically tractable form. This implies that the search for maxima will be difficult: there will be lots of local minima and global search will be prohibitively slow.
One way out of this dilemma is to use saccadic search: employing covariants for the similarity group that expresses invariances in the scene structure it is possible to reduce the global problem to a local one, which can then be dealt with by simple gradient methods. While this does not guarantee the finding of the global maximum in all situations, it can be shown in many cases that it provides a computationally feasible way of approximating the solution to the optimization problem.
To explore to what extent this is true some strategies for seeing have been developed and implemented through software that has been used in computer experiments to find the strengths and weaknesses of this methodology. Some results of these experiments will be shown.