Fusion-Based Robust Signal Processing by Humans and Machines

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Abstract

Although many existing automatic pattern recognition systems have achieved considerable success over the past fifty years, the performance of most of these systems deteriorates drastically in unpredictable and changing environments. These systems are typically trained on labeled training data sets, rely heavily on the use of dimension reduction, and as a result, their performance is governed by the extent that the training set represents the statistics of the application environment. The major shortcoming of these engineering systems is that their performance significantly depends on context and environmental settings. In contrast, biological systems seem to be much more resilient to the environmental changes that are not relevant to their recognition tasks. The differences in the performance between machine and biological learning approaches motivated us to explore new methods for pattern recognition based on high-dimensional representation, learning with partial information, and on rapidly adapting information fusion.

In the first part of my presentation, I will discuss the notion of robustness and some of the reasons for the deterioration in performance in typical pattern-recognition systems that are based on dimension reduction. I will then illustrate several relevant properties of human perceptual systems. In the third part of the talk I will describe ways that a pattern-recognition system can confront the problem of unpredictable and changing environmental conditions. In both of these approaches, the system incorporates high-dimensional representation.