Chapter 7

A Biologically Inspired Evolving Spiking Neural Model with Rank-Order Population Coding and a Taste Recognition System Case Study

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ABSTRACT

The human brain has an amazing ability to recognize hundreds of thousands of different tastes. The question is: can we build artificial systems that can achieve this level of complexity? Such systems would be useful in biosecurity, the chemical and food industry, security, in home automation, etc. The purpose of this chapter is to explore how spiking neurons could be employed for building biologically plausible and efficient taste recognition systems. It presents an approach based on a novel spiking neural network model, the evolving spiking neural network with population coding (ESNN-PC), which is characterized by: (i) adaptive learning, (ii) knowledge discovery and (iii) accurate classification. ESNN-PC is used on a benchmark taste problem where the effectiveness of the information encoding, the quality of extracted rules and the model’s adaptive properties are explored. Finally, applications of ESNN-PC in recognition of the increasing interest in robotics and pervasive computing are suggested.

INTRODUCTION

Our sense of taste is a vital part of our existence. It discriminates between foodstuff (such as vegetables, meats, tea, mineral waters), assesses their quality and nutritious content and detects potentially poisonous substances. In sharp contrast to its importance, the taste sensory system is poorly explored compared to other sensory systems such as the visual and olfactory systems. Only recently have studies started to paint a picture of taste biol-
Figure 1. Block diagram of an artificial taste recognition system. The system comprises an array of sensors modeling the tongue, i.e. an electronic tongue, and a pattern recognition system classifying the tastants.