STUDY OF STELLAR POPULATIONS USING NEURAL NETWORK TECHNIQUES

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1. Introduction

In this paper we consider a first application of the Learning Vectorial Quantification Neural method (LVQ) to the problem of studying and distinguishing between different populations within an stellar catalogue of the solar neighbourhood (a complete description can be found in Hernández-Pajares and Monte, 1991, *Artificial Neural Networks*, Ed. A.Prieto, *Lecture Notes in Computer Science* 540, Springer-Verlag, p.422). It consists, briefly, in the approximation of a set of vectors in a certain characteristic space that contains continuous elements. The representative points for every cluster are the centroids, calculated in such a way to minimize the distortion. Each of those can be labeled with integer numbers using a 2D representation that preserves the neighbouring property in the characteristic space: the Kohonen Map (Kohonen, 1988, IEEE Computer, **21** Nbr.3).

2. Calculations and results

The observational data considered is the Figueras (1986, Ph. Thesis, U. Barcelona) catalogue, which contains 12824 stars. The LVQ method has been applied working in the 14 dimensional characteristic space formed by 3-D position, velocity and residual velocity, jointly with spectral-photometric data. In the calculations we have taken a number of 8x8=64 14-dimensional centroids to be determined into the Kohonen map after 4×10^6 training iterations of the neural network.

A systematic, smooth and coincidental distribution of the distance and the residual velocity perpendicular to the galactic plane ($|W1|$) over the Kohonen map, appears as the main result. If we consider $|W1|$ in function of the distance to the galactic plane for the 64 centroids, we can distinguish between three groups of neighbouring centroids in the Kohonen map: (A) with $|W1| \leq 24$ Km/s, (B) with $24 < |W1| \leq 60$ Km/s and (C) with $|W1| > 60$ Km/s. These intervals deduced without any extra-statistical consideration, agree very well with the kinematic bins considered by Carney, Latham and Laird (1989, Astron. J. **97**, 423), related to the Galaxy populations: region (A) with a predominant Thin Disk component, (B) with the Thick Disk and (C) with the Halo population. In addition, jumps between the three intervals, especially the one between (B) and (C) could be concordant, without taking into account the bias of the sample, with a discrete nature of the Thick Disk; a matter of discussion nowadays (Gilmore, King and Van der Kruit, 1989, *The Milky Way as a Galaxy*, Geneva Obs., Switzerland).