LATEST DEVELOPMENTS FOR A SELF ORGANIZING MAPS PATTERN RECOGNITION OF SEISMIC NOISE RECORDS AND AN APPLICATION TO THE SEISMIC MICROZONATION OF SALTA CITY, ARGENTINA.

Roberto CARNIEL[1], Luca BARBUI[2], Lía OROSCO[2,3], Jorge TORRES[2,3], José VIRAMONTE[3], Silvina GUZMÁN[3,4]
1: DICA, Università di Udine, Via delle Scienze, 208 - 33100 Udine, Friuli, Italia.
2: Instituto de Estudios Interdisciplinarios de Ingeniería, Universidad Católica de Salta, Campo Castañares, 4400, Salta, Argentina
3: Instituto Geonorte, Universidad Nacional de Salta, Avda. Bolivia 5150, 4.400, Salta, Argentina
4: IBIGEO (CONICET-UNSa), Museo de Ciencias Naturales, Universidad Nacional de Salta, Mendoza 2, 4400, Salta, Argentina

This work improves the proposed (Carniel et al., 2009) use of Self-Organizing Maps (SOM: Kohonen, 1982) for the H/V spectral ratios (HVSR: Nakamura, 1989) when data are noisy and of short duration. Improvements with respect to the original paper concern the FFT algorithm (that has been replaced by Welch´s implementation), map topology, and the possibility of choosing triangle widths to calculate the weighted cross-correlation between patterns. A narrow triangle allows to identify narrow peaks of the H/V function and generally increases the number of clusters on the map, while a wide triangle produces a less “specialized” map and usually fewer and more meaningful larger clusters. With respect to map topology, in a flat map the neurons along the edges do not have the same number of neighbours as the other neurons, and this makes the training more difficult. A solution can be obtained e.g. by adopting a toroidal map connecting the upper and lower edges of the flat map, getting a cylinder and then merging its bases.

After the training, the meaning of H/V spectral ratio clusters has to be investigated. An algorithm of cluster recognition can be applied, using the weighted cross-correlation to calculate the similarity value of the neuron code vectors. At any threshold similarity value a given number of clusters are detected onto the map: the lower the threshold, the larger is the number of (small) clusters that are recognized. Identifying the main cluster, in most cases, means being able to obtain the most stable shape of the H/V function for the investigated site, characterized by a quite low standard deviation (in amplitude) as required by SESAME guidelines (SESAME, 2004). Moreover, SOM analysis allows to preserve the temporal information. For this reason, as data are presented by the neural network temporally ordered, considerations about data clustering results can help to understand if the properties of each cluster are stable in time (as expected for a site effect) or not. An example of application is shown for short and noisy HVSR recordings in Salta City, Argentina.

Carniel R., Barbui L. & Malisan P. (2009): Improvement of HVSR technique by self-organizing map (SOM) analysis. Soil Dyn. and Earthq. Eng. 29, 1097–1101.
Kohonen T. (1982): Self-organised formation of topologically correct feature map. Biol. Cyb. 43, 56–69.
Nakamura Y. (1989): A method for dynamic characteristic estimation of subsurface using microtremor on the ground surface. Quart. Report of Railway Techn. Res. Inst. 30(1), 25–33.
SESAME (2004): Guidelines for the implementation of the H/V spectral ratio technique on ambient vibrations measurements, processing and interpretation. EU research project.