The aim of this work is to develop a new system to detect welds between steel coils. This detection is carried out by a Kohonen Self-Organizing Map (SOM).

In order to achieve good results, a set of experiments have been carried out. On the one hand, we pay special attention to the selection and preprocessing of the input data parameters, which are supplied by an artificial vision system currently working in a real steel making process. On the other hand, we take care of the training parameters, such as the evolution of the neighborhood radius and the learning rate, and of the criterion to assign each neuron to a particular cluster.

From these experiments we have performed a statistical analysis and found a specific Self Organizing Map, that reaches a sensitivity of 0,975 and a precision of 0,638. This means that our system keeps a similar value for sensitivity with respect to the currently running system (0,975 vs 0,986), and improves precision in a 22,4% (0,638 vs 0,414).

As a secondary result of our work, we have also developed an interface in order to organize the design and testing of the different experiments.

### Planning of experiments

- **Input samples:** patterns of detections (P) (parameters supplied by the vision system: votes, threshold, borders, variance, contrast, gradient and vertical origin), or the first 3 components of a Principal Component Analysis on this pattern of detection (ACP3).
- **Input vector:** in the case that the input samples are patterns of detections, components of the input vector can be 7 features (C_i) or 6, one can be removed (C_6 = 1.7).
- **Normalization applied to the input samples:** without normalization (N_0) or one that is a particular selection designed by us (S).
- **Threshold, borders, variance, contrast, gradient and vertical origin.**

We consider the threshold, borders, variance, contrast, gradient and vertical origin because it has an improvement precision of 22,4% maintaining the sensitivity in 0,975.

In this practical case, the most important statistical characteristics are sensitivity and precision. On the one hand, sensitivity is meaningful because it reports the percentage of welds that have been recognized as such, and also reports the percentage of unrecognized welds. On the other hand, precision is key because it informs about false weld recognition.

#### Experiment 2: SOM $P - C_6 - N_0 - S - D_2$ ($\text{“Exp. 2”}$)

We have evaluated the performance of welding detection system installed on Acerinox: sensitivity of 0,998 and precision of 0,414.

We have analyzed a set of different SOM structures by changing the nature and the number of components of the input vector, the applied normalizations, the training parameters for learning and the way to attach neurons to clusters.

We have implemented a graphical user interface to facilitate the work.

We have found a particular model of SOM that improves precision a 22,4% and maintains sensitivity. This model achieves a precision of 0,638 and a sensitivity of 0,975.

### References

- www.cis.hut.fi/somtoolbox/ (last access: January 2016).