"Soft Optimal Computing Techniques to Identify and Control Surface Roughness in Manufacturing"

In Particle Swarm Optimization (PSO) algorithms, there is a delicate balance to be maintained between exploration (global search) and exploitation (local search) and this is one of the most important issues of this optimization method. In the first part of the talk an analysis of an increment of the dimension of the search space of the PSO is proposed. This is realized through an increment of its exploitation dimension to improve the precision of the search phase of the PSO, at the cost of more computations in each iteration. This new method is applied to the identification of the surface roughness in a milling process.

The second part of the talk, considering the same new PSO structures, takes into consideration the roughness as a function of rotation speed and feed velocity of the same milling metal handling process. A first PSO algorithm searches for the best bivariate polynomial based surface which fits the roughness measured points of the material as a combination of rotation speed and feed velocity. The second PSO algorithm searches for the minimal roughness of the milled material approximated with this fitting surface. To conclude, once the optimal rotation speed and feed velocity is obtained by the second PSO, two innovative control strategies to ensure a high surface quality are presented. These two strategies are based on Sliding Mode Control and of a combination between Sliding Mode Control and Flatness approach. Simulation results are shown to demonstrate the effectiveness of both approaches.