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SIMULATION AND EXPERIMENTAL VALIDATION OF STEEL SHEET LASER FORMING PROCESSES

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ABSTRACT

Experimental and numerical analyses of the thermomechanical behaviour that takes place in a stainless steel sheet during its forming by means of a low output power laser-based scanning system are presented in this work. To this end, a set of experiments under different operating conditions (e.g., scanning paths and velocities) has been conducted in order to measure the resulting bending angle at the end of various forming steps [1]. Figure 1 shows the geometric configurations of the sheet during a five-step laser forming sequence for a specific set of operating conditions [2]. It is seen that the highly localized heat flux provided by the laser promotes the development of a particular deformation pattern that enables the attainment of increasing bending angles after each laser application.

A coupled thermomechanical finite element plasticity-based formulation accounting for large strains and mechanical coupling effects is used to simulate this problem. Moreover, in order to achieve an adequate description of the material response, two additional tests aimed at deriving realistic thermal boundary conditions (e.g., the amount of reflected and absorbed heat flux together with the sheet-environment heat transfer coefficient due to convection-radiation effects) are previously carried out. Finally, the obtained numerical results are discussed and compared with the available experimental measurements.

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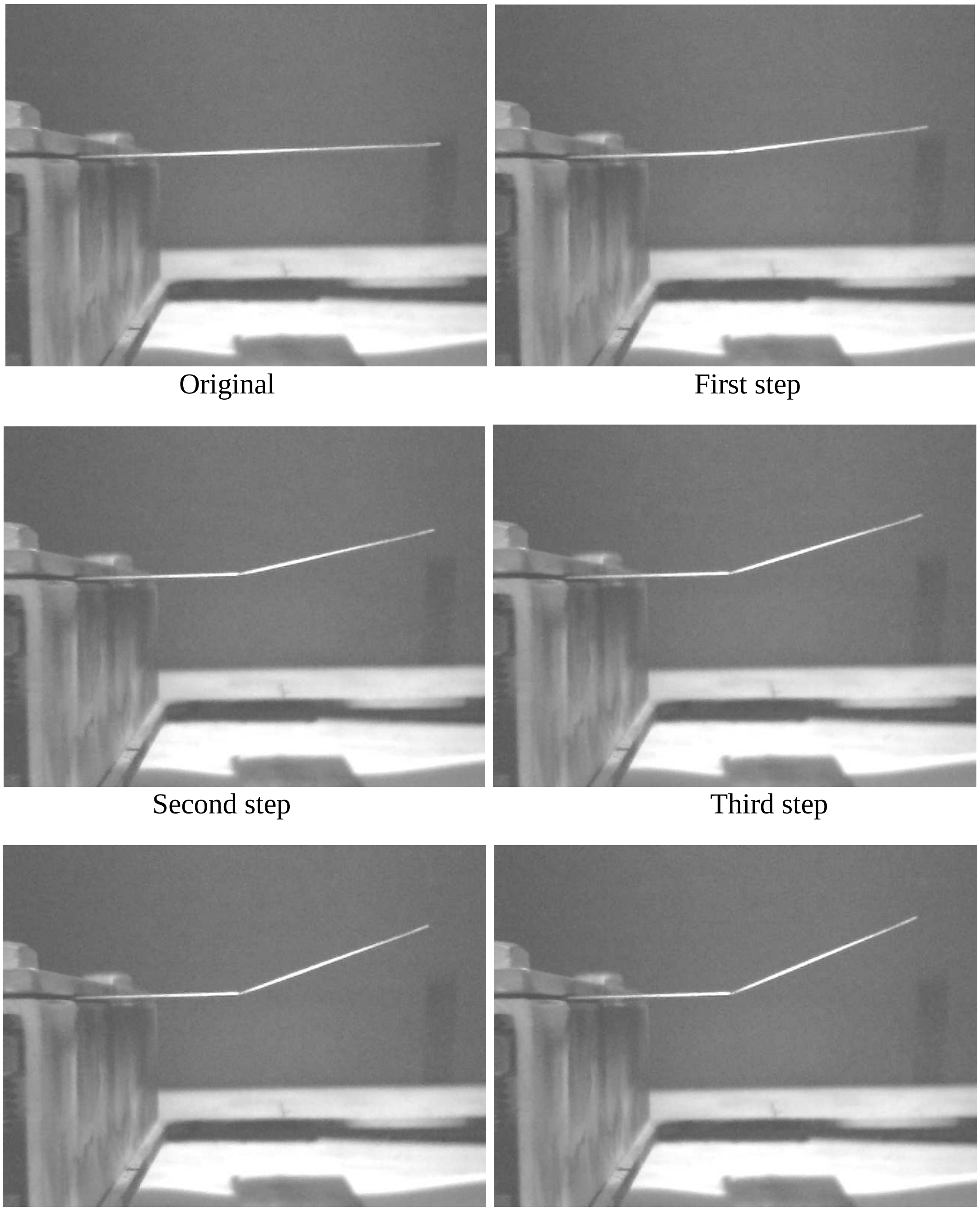

Figure 1. Geometric configurations of the sheet during a laser forming sequence considering a linear scanning pattern and a scanning velocity of 5 mm/s [2].

REFERENCES

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