Investigation on the feasibility of laser riveting for dissimilar joining applications

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In the transport sector, there is an increasing interest in lightweight structures, in order to meet emission targets dictated by legislation policies and improve the fuel economy of vehicles. Dissimilar joining enables the reduction of weights and enhances the overall vehicle performance by selecting the most appropriate material at specific locations. Laser riveting is an innovative technique that aims to improve the process flexibility and to reduce the processing time compared to traditional methods (mechanical fastening and adhesive bonding). It consists of joining two heterogeneous materials by additively manufacturing a rivet to interlock them. The rivet is built by wire-based laser metal deposition.

In this work, a feasibility study has been conducted to join an Al/Steel substrate onto a Ti6Al4V substrate. Both AA6061 Aluminium alloy and DP600 steel have been investigated. Process parameters have been varied in order to identify their effect on the features of the rivet and the quality of the joints, and further trial is carried out on the application of composite. The experimental analysis has been combined by a finite element analysis (FEA), in order to generate a model, capable of predicting the process behaviour and produce a better understanding of the process dynamics.