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Optimization of Weld Geometry for Fatigue Loading



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Introduction

This research aims to investigate the optimum geometry of weldments created by laser welding to minimize the stress concentration and maximize the fatigue strength of the joints under combined loading. In order to achieve the goal mentioned above, the Evolutionary Multi-objective Optimization software (modeFRONTIER) integrated with a mechanical model implemented in the F. E. Code (ABAQUS).will be used.

Research Objectives

- Prepare and study mechanical properties of welded joints (tensile test, Vickers hardness, fatigue strength).
- Geometrical measurements of weldment
- Finite Element simulation of weldment by (ABAQUS)
- Performing comparative study of Evolutionary Multi-objective Optimization algorithms to identify the accuracy and efficiency of each algorithm .
- Optimization study of welded joints by integrating F. E. Code (ABAQUS) with optimization software (modeFRONTIER).

Experimental Investigation

- Material of welded joints.
- Tensile test
- Vickers hardness of base metal and (HAZ)
- Fatigue test
- Geometrical measurement of welded joints b y using dental molding technique to identify the weld parameters (weld toe radius, weld toe angle, weld width)

Finite-Element models of welded joints

a parametric study has been performed to investigate the affect of

- Geometrical parameters (weld toe radius, weld toe angle, weld reinforcement and weld width)
- Load parameters (tensile and bending loads)
- Modelling parameters (arc and spline modelling of HAZ).

On elastic stress concentration factor k_t (SCF) in weldement.

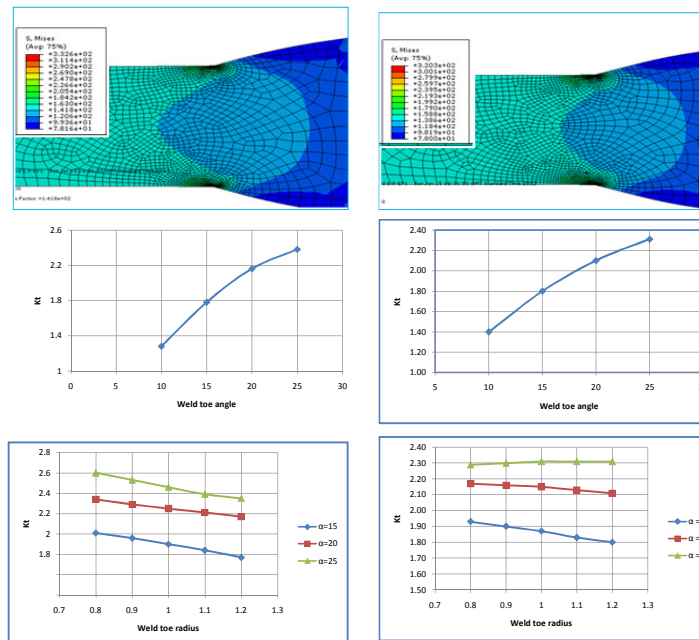


Fig. 1 Circular arc modelling of welded joint under tensile load

Fig. 2 Spline modelling of welded joint under tensile load

Optimization software (modeFRONTIER)

- Performed a comprehensive comparison between multi-objective optimization algorithms (MOGA-II, ARMOGA, NSGA-II, FMOGA, MOSA, MOPSO) in mechanical ,convex and concave problems.
- Different metrics are used to evaluate algorithms (Hit-rate , Convergence, Spacing metrics) and graphical representation of results.

Integratation between (ABAQUS) and (modeFRONTIER)

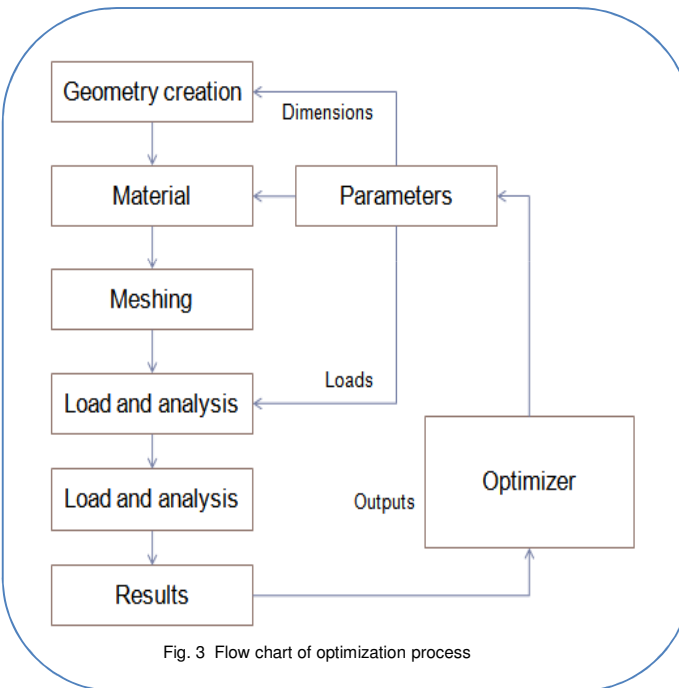


Fig. 3 Flow chart of optimization process