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Machine learning prediction and optimization of resistance spot welding tensile shear characteristics parameters in AISI 316L and DSS 2205 stainless steel alloys

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Abstract

This study investigated the tensile shear strength of resistance spot welds joining duplex stainless steel (DSS 2205) and austenitic stainless steel (AISI 316 L). Researchers varied key input parameters to assess their impact on joint strength and quality. Welding current was set at 5000 A, 6000 A, and 7000 A. Electrode tip diameter was tested at 4 mm and 8 mm. Welding pressure remained fixed at 4 MPa, while welding time ranged from 2 to 6 s. These parameter levels allowed systematic

of 0.31, root mean squared error of 0.56, and mean absolute error of 0.42. Predicted and experimental results showed strong agreement, validating the model and demonstrating that optimal welding parameters enhance joint performance and support efficient automation of dissimilar stainless-steel resistance spot welding.
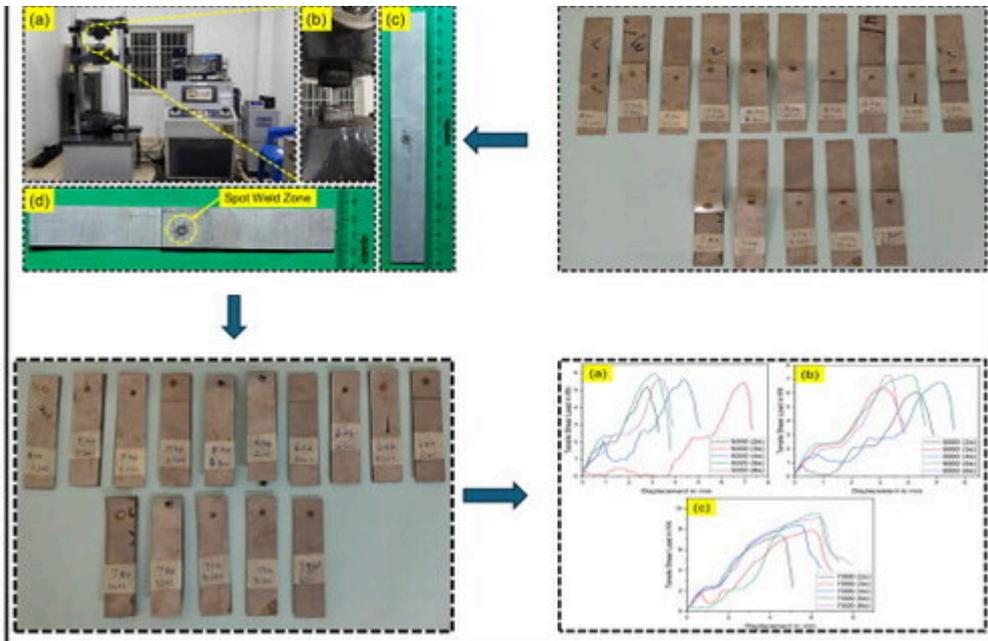
HIGHLIGHTS

- Tensile shear strength of DSS 2205/AISI 316L analysed using resistance spot welding.

- Maximum strength of 318.63 MPa achieved at 7000 A and 5 s welding time.

- XGBoost model predicted tensile shear strength accurately with R^2 = 0.99 performance.

- SEM and microstructural analyses validated relationships between welding parameters and strength.

- Experimental and XGBoost optimization improved joint strength and minimized welding distortion effectively.

Graphical Abstract

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Keywords:

Stainless steel alloys   resistance spot welding   structural analysis   tensile shear strength

machine learning prediction

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Disclosure statement

No potential conflict of interest was reported by the authors.

Data availability statement

Made available on request.

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