Composite Interfaces
Volume 31, 2024 - Issue 7

Research Article

An embedded machine learning strategy for analyzing interfacial characteristics in impact welding of dissimilar alloys

Arif Sari, Candra Zonyfar, Shavan Askar, Sherzod Abdullaev, Raaid Alubady & M. K. Sharma

Pages 821-841 | Received 17 Oct 2023, Accepted 16 Dec 2023, Published online: 21 Dec 2023

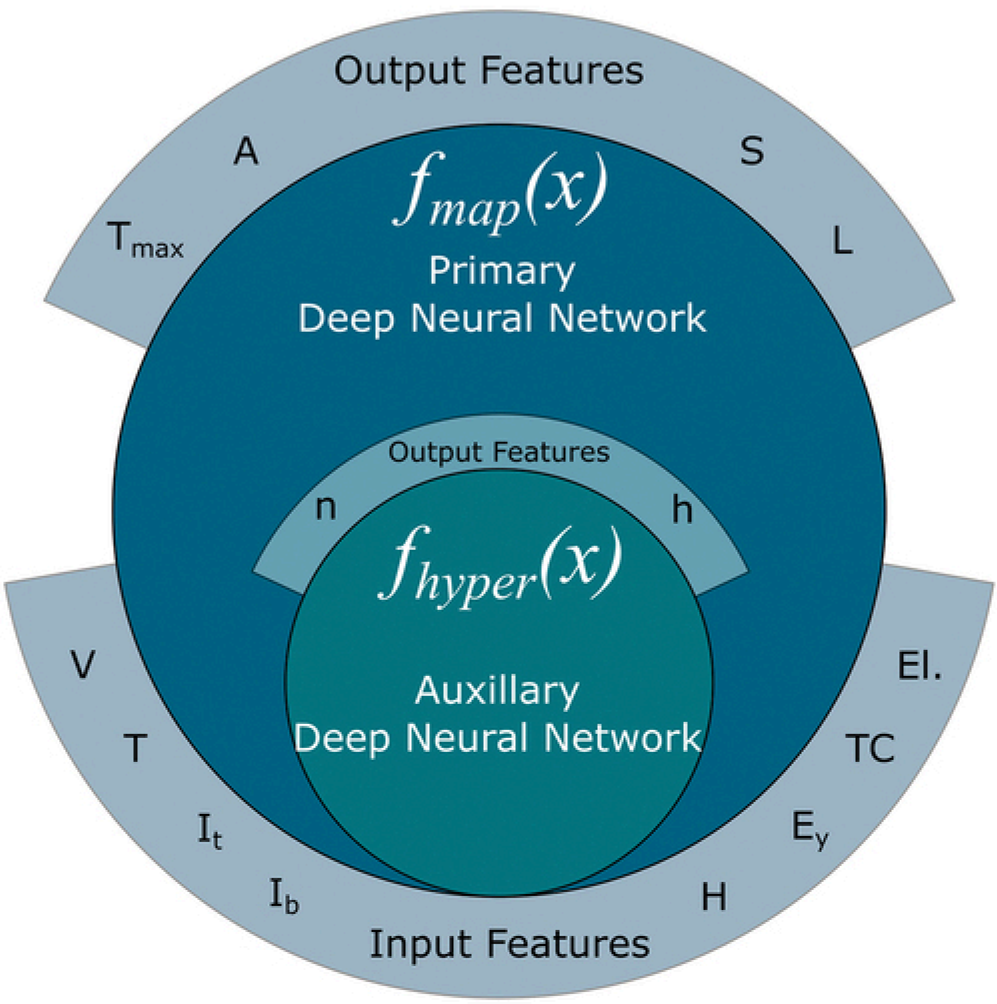
Cite this article https://doi.org/10.1080/09276440.2023.2298124

ABSTRACT

In this study, a novel embedded machine learning (ML) framework was employed to analyze interfacial characteristics in dissimilar-alloy impact welding. While keeping the substrates constant, i.e., stainless steel and Ti alloy, the influence of interlayer types on the resultant morphology of impact-welded bonds was also highlighted. The dataset was meticulously generated through numerical simulations, utilizing materials properties and processing parameters as primary inputs. These inputs were used to predict various interfacial features, including the extent of wave formation (L), specific welding zone area (S), average waveform amplitude (A), and maximum interface temperature (T_{max}).

Impressively, exceptional predictive capabilities were demonstrated by the ML model, with determination coefficients of 0.938, 0.924, 0.967, and 0.909 for S, L, A, and T_{max}, respectively. Based on the results, strong dependencies between interfacial features and the weight functions of materials properties and processing parameters were unveiled. Intriguingly, as the weight function of materials properties for a specific output objective increased, a corresponding decrease in the weight function of processing parameter inputs was observed. These findings emphasize the complex connection between input parameters and output characteristics, revealing previously unexplored intricacies in the impact welding process, facilitated by our advanced ML methodology.

Graphical Abstract



Display full size

KEYWORDS: Impact welding machine learning numerical simulations interfacial morphology

Disclosure statement

No potential conflict of interest was reported by the author(s).