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Linear Dependencies in Friction Stir Welding Conditions
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Friction stir welding is a solid-state process that joins materials using heat generation to soften the material to a state of plasticization, and mechanically inter-mixing the materials. The process generates a lower threshold of heat across the weld, therefore attaining a stronger weld through plasticizing rather than melting the materials together. In this study we observed conditions during the welding process including: position, heat distribution, current input, and torque across the tool-bit. Three specific revolutions per minute (rpm) of the tool-bit were observed: 1400, 1600, and 1800 rpm. Linear relationships were identified and analyzed between torque and current input, as well as heat distribution and current input. Post-weld analysis revealed linear slopes as small as -.0135 Amps per Newton meters across the duration of the weld for torque-current relationships, and as small as .0014 Amps per degree Celsius for the duration of the weld for heat-current relationships. These linear strategies could be effective control methods for future welds to procedurally detect the creation of weld defects.

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