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DIRECT NUMERICAL SIMULATION OF HEAT CONDUCTION ACROSS METAL-METAL CONTACTS TO EXTRACT THERMAL CONTACT RESISTANCE (TCR)

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ABSTRACT The thermal contact resistance (TCR) of metal-metal contacts was computed using scale-resolved direct numerical simulation (DNS) of thermal transport across the interface. In order to account for the micro-scale physics of the contact, the complex geometry of the interface and the associated length scales were resolved using an unstructured mesh. The interface scale models were first created using Python scripts which were developed to stochastically reconstruct the interfaces from commonly used surface topology descriptors, namely, the Center Line Average (R_a), the standard deviation of the asperity heights, and the asperity density. Using the commercial CFD code Ansys-Fluent, the solution of the steady state heat conduction equation was conducted to compute the temperature and heat flux distributions. Finally, TCR values were extracted out of the DNS results. When compared with experimental data, the predicted TCR values were found to be in good agreement, thereby validating the approach. The method was exercised to compute and curve-fit the TCR as a function of the separation distance between the mean planes of the two surfaces. The accuracy of the curve-fit data was verified by comparing TCR extracted from DNS results with TCR extrapolated from the curve-fit. The error between the results was found to be less than 5%.