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Measurement of material recession and shock standoff in plasma windtunnel using neural nets MAGNUS HAW, NASA Ames Research Center, ALEXANDRE QUINTART, Science and Technology Corp., NASA Ames Research Center — Arcjets are plasma wind tunnels used to test the performance of heatshield materials for spacecraft atmospheric entry. These facilities present an extremely harsh flow environment with heat fluxes up to 10^9 W/m^2 for up to 30 minutes. The plasma is low-temperature ($\sim$1 eV) but high pressure ($>$ 10 kPa) creating high-enthalpy supersonic flows similar to atmospheric entry conditions. Typically, material samples are measured before and after a test to characterize the total recession. However, this does not capture time-dependent effects such as material expansion and non-linear recession. This work will present new analysis of arcjet test videos which measure both the time-dependent 2D recession of the material samples and the shock standoff distance. New results showing non-linear time-dependent effects will be highlighted. The material and shock edges are extracted from the videos by training and applying a convolutional neural network. Due to the consistent camera settings, the machine learning model achieves high accuracy ($\pm$ 2 px) relative to manually segmented images with only a small number of training frames (80). The new results will be discussed in the context of temperature dependent plasma-surface interaction.

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