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10.45 Reconstruction and Analysis of Exploding Wire Particle Trajectories via Automatic Calibration of Stereo Images

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Quantitative understanding of the physics of dust or granular matter transport significantly impacts several aspects of burning plasma science and technology. This work takes machine vision techniques popular in robotics and self-driving cars and applies them to identification and analysis of microparticles generated from exploding wires. Using only the image frames and knowledge of the intrinsic properties of the cameras, a Python code was written to identify the particles, automatically calibrate the images, and extract trajectory data. After identifying approximately 50 particles based on the timing of secondary particle explosions, the Eight Point and Random Sample Consensus algorithms were used to determine the correlation between the cameras. Over 100 particle matches were found between the two camera views. These correlated trajectories were used in subsequent 3D track reconstruction and analysis of the physics behind the particle behavior. The 3D reconstruction resulted in accurate positioning of the particles with respect to the experimental calibration. The particle motion was consistent with the effects of a 1g gravitational field modified by drag forces. The methods and analyses presented here can be used in many facets of high temperature plasma diagnostics.

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