Extraction of high-contrast diffraction patterns of fine-structured electrical sparks from laser shadow images

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The fine-structured electrical spark appears in the laboratory gas discharge as a cluster involving dozens of closely-packed thin plasma filaments. To gain a deeper insight into the physics behind such spark, reliable data on its structure and characteristics of the transmitted radiation are of vital importance. However, immerse complicity of the spark, together with distortions and various defects of the optics involved in the laser imaging system, challenges the spark image processing. Herein, we present an iterative image denoising procedure for precise processing of shadow images of fine-structured sparks obtained by single-shot laser probing, implemented in a shadow photography system. By using the described procedure, we show that the passage of laser radiation through the fine-structured spark is accompanied by complicated diffraction, which, in turn, results in the high-contrast visualization of the spark microstructure in the entire discharge gap. The described procedure significantly advances processing of the laser shadow images of the fine-structured sparks as well as guarantees reliable quantitative data on the intensity characteristics of the transmitted laser radiation.

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