Image Processing Techniques Applied to Study Phase Separation in Microgravity

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A series of experiments were performed using the Alice II apparatus in microgravity to study phase separation near the critical temperature. Phase separation in a constant density sample was induced in the sample cell unit by temperature quenches in weightless conditions and was visualized using optical microscopy. In order to extract quantitative information from microscopic phase separation images, we tested different filters to eliminate for optical noise including the Gaussian, Wiener, and n-point filters. We found the n-point filter to be the most effective for these images. After the denoising process we were able to determine the fractal dimension of the phase separating domains. The size of the phase separating clusters was also found using image feature analysis. Two image segmentation methods were tested to analyze the growth of liquid and gas clusters during phase separation and the results were compared. The first method segments the images based on a gray-level threshold. The second method is the k-means clustering algorithm and is based on the number of classes and the mean values of the clusters.