Methods for Finding the Position of a Critical Point Using Image Analysis Techniques

Ana Oprisan [C, S]
College of Charleston, Charleston, SC, U.S.A.

John Hegseth
University of New Orleans, New Orleans, LA, U.S.A.

Sorinel Oprisan
College of Charleston, Charleston, SC, U.S.A.

Carole Lecoutre, Yves Garrabos and Daniel Beysens
University of Bordeaux, France

In order to study fluctuations and phase separation processes near a pure fluid's critical point without the influence of buoyancy, a set of experiments was performed in a microgravity environment. Local density fluctuations were observed by illuminating a cylindrical cell filled with sulfur hexafluoride near its liquid-gas critical point, and recorded using a microscope and a video recorder. Using image processing techniques, we were able to estimate the properties of the fluid from the recorded images showing fluctuations of the transmitted and scattered light. The characteristic length of the fluctuations was estimated from the maximum of the radial average of the power spectrum. Based on our method, the critical temperature was found from the ratio of the characteristic lengths for images recorded above and, respectively, below critical temperature. The second method we used to estimate the critical temperature from recorded images is based on the images' histogram. In the histogram method, we assumed that the variation of the scattered light intensity is proportional to the average value of the gray levels and that a small fluctuation of the fluid density induces a change in the scattered light intensity that can be measured from the histograms.