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AN INTELLIGENT CELL SENSOR SYSTEM IN SPACE

Abstract

Studies of effects of the space environment on mammalian cells began in the earliest days of spaceflight and have continued to the present. But, all space-based studies to date of cells in culture have been limited by technical limitations of the equipment available, only the results of cell experiment in space can be brought back to earth for analysis. Therefore, the absence of process information of cell culture leads to limitations on the design of experiments. So, the cell culture with real-time video microscopic methods in space is urgent. But, space environments (vibration, pressure, noise, etc.) may work on the imaging system, so the noise proof strategy and high performance are both significant. The right auto focusing and cell tracing and analysis methods must be emphasized. The purpose of this paper is to develop a novel automated cell sensor system and advanced methodologies for ground-based cell research, what is more, laying a foundation for the future long-term space-based cell researches. Firstly, the gray-level Laplacian is taken as a focus measure and a multi-point compared climbing method is introduced to achieve coarse autofocusing. Then, the discrete wavelet transform (DWT) is discussed to associate with precise focusing and image fusion. The two-level DWT and the complete expression of DWT are exposed in this paper. In our works, the sum-of-squares energy of the second-level detailed image (HF) of DWT is suggested as focus measure and a threshold (t) on the wavelet coefficients is set to increase the discriminative power of the focus measure in noisy condition. When focusing is approaching, the last three images near the focused image are stored to carry out a wavelet-based fusion. So, in the existing first-level wavelet domain, the LF coefficients are calculated the average value of related three LF coefficients. A threshold (th) is also needed for the HF coefficients, since noises usually act as HF coefficients in wavelet domain of micrographs. By taking an inverse DWT, the improved image is obtained. Secondly, a cell segmentation and analysis method based on mathematical morphology is presented. The threshold value of each pixel in the gray image is decided to select adaptively dilation and erosion of the morphology basic operation as detecting the threshold value of image. Then, dilation and packing is performed. Therefore, the cells could be traced in period serial images. According to the parameter of microscope, the results could be converted to the real cells information.