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A VARIATIONAL COUPLED MODEL FOR JOINT SUPER-RESOLUTION AND SEGMENTATION IN A DIAGNOSTIC IMAGING SYSTEM

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Summary: Objective:Immunofluorescence diagnostic systems cost is often dominated by high-sensitivity, low-noise CCD-based cameras which are used to acquire the fluorescence images. In this paper we investigate the use
of low-cost CMOS sensors in a point-of-care immunofluorescence diagnostic application for the detection and discrimination of four different serotypes of the Dengue virus in a set of human samples. Methods:
A two-phase post-processing software pipeline is proposed which consists in a first image enhancement stage for resolution increasing and segmentation, and a second diagnosis stage for the computation of the output concentrations. Results: We present a novel variational coupled model for the joint super-resolution and segmentation stage, and an automatic innovative image analysis for the diagnosis purpose. A specially designed Forward Backward-based numerical algorithm is introduced and its convergence is proved under mild conditions. We present results on a cheap prototype CMOS camera compared with the results of a more expensive CCD device, for the detection of the Dengue virus with a low-cost OLED light source. The combination of the CMOS sensor and the developed post-processing software allows to correctly identify the different Dengue serotype using an automatized procedure. Conclusions: The results demonstrate that our diagnostic imaging system enables camera cost reduction up to 99%, at an acceptable diagnostic accuracy,
with respect to the reference CCD-based camera system. The correct detection and identification of the Dengue serotypes has been confirmed by standard diagnostic methods (RT-PCR and ELISA).