

Registration of hyperspectral images of the retina

submitted by Optina Diagnostics

Optina Diagnostics has developed a prototype hyperspectral camera allowing the sequential acquisition of retinal images in the spectral range between 900 and 450nm with a 5nm step. A set of hyperspectral data thus consists of a “cube” of images in which a (spectral, one-dimensional) vector is associated with each pixel of the (spatial, two-dimensional) scene. Although the acquisition of these 91 images is carried out within one second (given that the speed is 100 images per second), eye movements may still occur during this period. In order for the spectral analysis to be relevant, it is imperative to register these images with subpixel precision. Compared to a video obtained with an illumination with constant spectral content, the information contained in the hyperspectral images varies considerably from one spectral region to another (for example, blood absorbs much more light in the green part of the spectrum, around 540 nm); this makes the registration more complex.

In the past few years Optina Diagnostics has developed a registration algorithm that generally yields good results (subpixel precision) but whose computing time is relatively large (45 minutes with MATLAB on a personal computer). The automatic and quantitative assessment of the registration quality is also a very important issue. Optina Diagnostics would like to know whether a fresh look at these issues could lead to new and relevant approaches.

The proposed problem therefore concerns:

1. the design of a registration algorithm for retinal hyperspectral images yielding subpixel precision within a maximal processing time of a few minutes on a personal computer; and
2. the identification of quantitative metrics (to be computed automatically) to assess the registration of the retinal hyperspectral images.