

Computer-aided Diagnosis of Retinopathy of Prematurity

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The structure of the blood vessels in the retina is affected by diabetes, hypertension, arteriosclerosis, retinopathy of prematurity (RoP), and other conditions through modifications in shape, width, and tortuosity. Quantitative analysis of the architecture of the vasculature of the retina could assist in monitoring the evolution and stage of pathological processes, their effects on the visual system, and the response to treatment. Computer-aided detection, modeling, and quantitative analysis of features related to the retinal vascular architecture could assist in consistent, quantitative, and accurate assessment of pathological processes by ophthalmologists.

This seminar provides details on digital image processing and pattern recognition techniques for the detection and analysis of retinal blood vessels, detection of the optic nerve head, modeling of shape for quantitative analysis of the temporal arcades, measurement of the thickness of retinal vessels, and detection of tortuous vessels. The techniques include methods for the detection of curvilinear structures, the Hough transform, Gabor filters, phase portraits, and specific algorithms for quantitative analysis of patterns of diagnostic interest. Analysis of a dataset of retinal fundus images of 19 premature infants with plus disease, a proliferative stage of RoP, and 91 premature infants without plus disease resulted in an area under the receiver operating characteristic curve of up to 0.98 using our parameter to quantify tortuosity. A graphical user interface is being developed to facilitate clinical application of the methods. The methods should assist in computer-aided diagnosis, follow up, and clinical management of premature infants possibly affected by RoP.