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信息科学

基于半盲解卷积复原的高分辨率视网膜成像系统

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摘要： 为获得高分辨率视网膜图像,建立了基于自适应光学的视网膜成像系统,并以成像时获得的残余像差作为图像复原的估计参数,通过半盲解卷积进行图像复原以获得高质量图像。通过Hartmann-Shark波前传感器和微机械薄膜变形镜组成的自适应光学系统对活体人眼像差进行测量与校正,并在成像时记录系统残余像差,据此重建光学传递函数作为图像复原模型初始参数估计,对获得的视网膜图像进行条件约束迭代半盲解卷积复原,消除像差对成像质量的影响,从而得到高分辨率视网膜图像。实验表明,系统获得的图像经该方法处理后可获得较满意视网膜图像,图像质量提高近一倍,成像成功率由38%提高至78%,成像时间缩短为原来的1/7。该方法在满足使用要求的前提下有效缩短了校正时间,提高了成像的成功率,提升了系统的适用范围。

关键词： 自适应光学 视网膜成像系统 解卷积 图像复原 光学传递函数

High resolution retinal imaging system based on semi-blind deconvolution restoration

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Abstract: To obtain high resolution human retinal images, an adaptive optical system for retinal imaging was established. In the system,the residual aberration of the imaging system was used as initial parameter estimation for image restoration to get high resolution images by semi-blind deconvolation.First,the adaptive optical system consisting of a Hartmann-Shark wavefront sensor and a micromachined membrane deformable mirror was use to correct the dynamic human eye wavefront aberrations and to access the residual aberration of system when retinal images were capturing. Then,the optical transfer function was used as initial parameter estimation of image deconvolution modal to perform the iterative semi-blind constraint deconvolution on the retinal image and to eliminate the influence of residual aberration on imaging quality and obtain the high resolution retinal images. The experiment results show that satisfactory retinal image can be gotten by the proposed method. The image quality has been improved nearly once, and the success rate of imaging has raised from 38% to 78%. Meanwhile, the correction time reduces by 6/7. It concludes that the calibration time is reduced effectively, the success rate of imaging is improved, and the the scope of application is expanded by proposed method.

Keywords: adaptive optics retinal imaging system deconvolution image restoration optical transfer function

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