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Digital Tracking and Control of Retinal Images

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Laser induced retinal lesions are used to treat a variety of eye diseases such as diabetic retinopathy and retinal tears or breaks. Both the location and size of the retinal lesions are critical for effective treatment and minimal complications. Currently, once an irradiation is begun, no attempt is made to alter the laser beam location on the retina. However, adjustments are desirable to correct for patient eye movements. Lesions form in much less than one second and typical treatment for a disease such as diabetic retinopathy requires as many as 2000 lesions per eye. This type of tedious task is ideally suited for computer implementation.

A system has been developed to track a specific lesion coordinate on the retinal surface and provide corrective signals to maintain laser position on the coordinate. Six distinct retinal landmarks are tracked on a high contrast retinal image using two-dimensional blood vessel templates. Use of therapeutic lesions as tracking algorithm landmarks is also investigated. An X and Y laser correction signal is derived from the landmark tracking information and provided to a pair of galvanometer steered mirrors to maintain the laser on a prescribed location. Once the laser position has been corrected, a function checks the terminal laser position for minor corrections.

A development speed tracking algorithm has been implemented and tested using both vessel and lesion templates. Closed loop feedback control of laser position is demonstrated with calibrated retinal velocities and *in vivo* testing of the development system.

Trade off analysis of parameters affecting tracking system performance is provided. The analysis is used to specify requirements and implementation details for a real time system.

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