Staring Into Your (Dry) Eyes: Monitoring the Pre-Lens Tear Film From Narrowband Interferometry

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4 P.M.
8 Saint Mary’s St., Room 211
Refreshments will be served outside Room 339 at 3:45 p.m.
Faculty Host: Janusz Konrad

Dry eye problems plague many people, especially wearers of contact lenses. In this talk Professor Boyer will present an approach to reconstructing the dynamic tear film surface from interferometric video to evaluate therapies and to support modeling of the tear film’s fluid dynamics. A better understanding of these dynamics will reveal the root causes and lead to improved treatments. First, he and his research team develop a texture based segmentation approach to identify dry regions. Because of the complexity of the class conditional distributions of wet and dry regions, they introduce Resilient Mixture Discriminant Analysis as a new Gaussian clustering method for high dimensional classification problems. The new method maintains the adaptability of subclass discriminant analysis but offers superior feature selection performance.

Next, to reconstruct the tear film surface over the wet regions Boyer will present a novel method to solve the sign ambiguity for phase demodulation from a single image that possibly contains closed fringes. The problem is formulated in a Markov random field energy minimization framework with the assumption of phase gradient orientation continuity. Compared with traditional path following phase demodulation methods, the new approach requires no heuristic scanning strategy, is not subject to the propagation of error, and the extension to three dimensional fringe patterns is straightforward. A set of experiments with synthetic and real prelens tear film interferometric images of the human eye demonstrates the effectiveness and robustness of the algorithm as compared with the prior state of the art.