Parameter Estimation for Tear Film Thinning

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Abstract: Tear film breakup (TBU) is closely related to dry eye syndrome, a condition that causes ocular discomfort and decreased quality of vision. Etiologies of TBU include evaporation-driven, divergent flow-driven and a combination of these two. TBU quantities such as evaporation rates and tangential flow rates cannot be directly measured during breakup. We determine such variables by fitting mathematical models for (i) evaporation-driven and (ii) mixed-mechanism TBU to experimental data gathered *in vivo*. Parameter estimation is conducted via least squares minimization of the difference between experimental data and computed answers using the Levenberg-Marquardt method. Best-fit determination of TBU parameters in faster cases supports the notion that evaporation and divergent tangential flow can cooperate to drive breakup; purely evaporative cases tend to exhibit slower thinning. Our optimal thinning rates for both (i) and (ii) are comparable to available measurements. These results are a step towards characterizing what causes a wide range of TBU instances and can help medical professionals to better understand tear film function and dry eye syndrome.