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Rigorous Error Estimates for Reynolds' Lubrication Approximation JON WILKENING, U. C. Berkeley Mathematics — Reynolds' lubrication equation is used extensively in engineering calculations to study flows between moving machine parts, e.g. in journal bearings or computer disk drives. It is also used extensively in micro- and bio-fluid mechanics to model creeping flows through narrow channels and in thin films. To date, the only rigorous justification of this equation (due to Bayada and Chambat in 1986 and to Nazarov in 1987) states that the solution of the Navier-Stokes equations converges to the solution of Reynolds' equation in the limit as the aspect ratio ε approaches zero. In this talk, I will show how the constants in these error bounds depend on the geometry. More specifically, I will show how to compute expansion solutions of the Stokes equations in a 2-d periodic geometry to arbitrary order and exhibit error estimates with constants which are either (1) given in the problem statement or easily computable from $h(x)$, or (2) difficult to compute but universal (independent of $h(x)$). Studying the constants in the latter category, we find that the effective radius of convergence actually increases through 10th order, but then begins to decrease as the inverse of the order, indicating that the expansion solution is probably an asymptotic series rather than a convergent series.

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