Evolution of Curves and Surfaces: Closure Relations of Ray Equations, Kinematical Conservation Laws (KCL), Weakly Nonlinear Ray Theory and Curvature Driven Evolution

Phoolan Prasad

Department of Mathematics, Indian Institute of Science,
Bangalore 560012, India
Email: prasad@math.iisc.ernet.in

Abstract

In this presentation we review some methods for evolution of curves and surfaces Ω_t. The methods are

1. The level set method by Sethian,

2. The fast marching method of Osher and Sethian,

3. Method based on introduction of ray coordinates associated with Ω_t and

4. Kinematical Conservation Laws.

We present some results and suggest comparison of these results by intensive numerical computation. Introduction of ray coordinates simplifies tracking of the successive positions of the surface. Formulation in terms of KCL has further advantages. The first two methods have been discussed intensively both theoretically and with numerical results on many practical problems. However, these methods can not reproduce appearance of a special singularity on Ω_t, namely kinks across which the normal to Ω_t and the velocity of Ω_t have finite jumps. Further the computational efficiency of last two methods are equally good. We also highlight a case when further theoretical development is required in order to make the last two methods applicable to curvature driven Ω_t.