THE DARBOUX VECTOR AND AREAL VELOCITY PROJECT

DIFFERENTIAL GEOMETRY, SPRING 2015

Central Theme

There is a physical interpretation of the Frenet-Serret Apparatus due to Gaston Darboux which involves the notions of areal velocity and angular momentum. In this set-up, you consider the motion of the Frenet framing as somehow telling you about the motion of a rigid body in space. This is also referred to as a *cinematical representation*.

Minimum Requirements

Write a paper exploring the basics of the Darboux cinematical representation.

- 7-10 pages, in LaTeX, with attention paid to standard English grammar, spelling and usage.
- Give a clear definition of the Darboux vector, and discuss the proper interpretation.
- What is areal velocity, and how is it relevant here?
- Discuss the connection between the Frenet-Serret apparatus and the mechanics.
- Compute several examples, including at least these: a line, a circle, a circular helix, Viviani's curve (Struik example (3) on pages 9–10), the twisted cubic (Shifrin page 3).
- Include images where appropriate.
- Show how to interpret the curvature, κ, and the torsion, τ, in this set-up.

Resources

Struik mentions this material in exercise §1.6#18. The challenge in this project is that I don't have other resources to give you!