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Topological Features in Vector Fields

Thomas Wischgoll and Joerg Meyer

Vector fields occur in many application domains in science and engineering. In combustion processes, for instance, vector fields describe the flow of gases. This process can be enhanced using vector field visualization techniques. Also, wind tunnel experiments can be analyzed. An example is the design of an air wing. The wing can be optimized to create a smoother flow around it. Vector field visualization methods help the engineer to detect critical features of the flow. Consequently, feature detection methods gained great importance during the last years. Methods based on topological features are often used to visualize vector fields because they clearly depict the structure of the vector field. Most algorithms basically focus on singularities as topological features. But singularities are not the only features that typically occur in vector fields. To integrate other features as well, this paper defines a topological feature for vector fields based upon the asymptotic behavior of the flow. This article discusses techniques that are able to detect this feature.