Special Guest Lectures

Topology-based Smoothing of 2D Scalar Fields with C1-Continuity

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Abstract:
Data sets coming from simulations or sampling of real-world phenomena often contain noise that hinders their processing and analysis. Automatic filtering and denoising can be challenging: when the nature of the noise is unknown, it is difficult to distinguish between noise and actual data features; in addition, the filtering process itself may introduce artificial features into the data set that were not originally present. We propose a smoothing method for 2D scalar fields that gives the user explicit control over the data features. We define features as critical points of the given scalar function, and the topological structure they induce (i.e., the Morse-Smale complex). Feature significance is rated according to topological persistence. Our method allows filtering out spurious features that arise due to noise by means of topological simplification, providing the user with a simple interface that defines the significance threshold, coupled with immediate visual feedback of the remaining data features. In contrast to previous work, our smoothing method guarantees a C1-continuous output scalar field with the exact specified features and topological structures.

Speaker's Bio:
Tino Weinkauf studied computer science with the focus on computer graphics at the University of Rostock, Germany, where he received his M.S. degree in 2000. Based on his research carried out at the Scientific Visualization department of Zuse Institute Berlin (ZIB) on feature-based analysis and comparison techniques for flow fields he received his awarded PhD in computer science from the University of Magdeburg in 2008. Since 2009 he performs research at the Courant Institute of Mathematical Sciences, New York University, based on a Feodor Lynen research fellowship of the Alexander von Humboldt foundation. His current research interests focus on flow and tensor analysis, geometric modeling, and information visualization.