

Deep Structure, Singularities, and Computer Vision

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What is actually the information directly represented in the scale-space? I started to wonder about this shortly after Peter Johansen, 15 years ago, showed me his intriguing paper on how uniquely to reconstruct a band-limited 1D signal from its scale-space topoints. Still, I have not fully understood its implications. Merely recording where structure vanishes under blurring is sufficient to fully reconstruct the details. Of course, technicalities exist, for example, you must also know negative scale topoints. Nevertheless, I find it surprising that we may trade the metric properties of a signal with the positions of its inherent structure. The result has been generalized to analytic signals, shown also for the zero crossings of the Laplacean, but has not yet been generalized to 2D. This remains an open problem. In 2003, Peter Giblin, Liverpool University, Luc Florack, Eindhoven University of Technology, Jon Sporring, University of Copenhagen, my colleague Ole Fogh Olsen, and several others started the project collaboration Deep Structure and Singularities in Computer Vision under the European Union, IST, Future and Emerging Technologies program, trying to obtain further knowledge about what information is actually carried by the singularities of shapes and gray-scale images. In this project, we probed from several directions the question of how much of the metric information is actually encoded in the structure of shapes and images. We, and many others, have given hints in this direction.



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