List of Papers

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Introduction: a summary of research conducted at Stevens Institute of Technology.

I published what I regard as one of my two best papers (J Oliensis, "The Least-Squares Error for Structure from Infinitesimal Motion," IJCV 61:3, 259–299, 2005), the other being my early shape-from-shading work with Paul Dupuis. About half of the work for this paper was done at Stevens. It is a fundamental theoretical investigation of the structure-from-motion optimization problem—specifically, a characterization of the behavior of its objective function. Before starting this work, I wasn't sure it would be possible to give a faithful yet intelligible account of this. I expect the analysis to yield better algorithms, as to some extent it has already. The paper continues to be relevant despite recent algorithms that guarantee (nearly) the global optimum, since these algorithms are limited to the simpler structure from motion problems, whereas my paper's insights can apply more generally.

I published a dense theoretical and experimental investigation of the iterated Sturm/Triggs algorithm (J Oliensis and R. Hartley, "Iterative extensions of the Sturm/Triggs algorithm: convergence and nonconvergence," PAMI 29:12 2217-2233, 2007), which points out serious flaws in previous versions of the approach and proposes a new version without these flaws. About 90% of the work was done at Stevens; also about 90% of the paper was my contribution. Several of the proofs are elegant or nontrivial. The focus though deep is narrow; this is justified by the importance of Sturm/Triggs.

A recent paper with my student Hongzhi Wang appears this year at ECCV 08 (Hongzhi Wang and JO, "Shape Matching by Segmentation Averaging"). A journal version will be completed in November 2008. This work addresses the question of how to use intermediate representations obtained by perceptual organization for recognition. The crucial issue is overcoming the unreliability of bottom-up perceptual organization. We show that segmentations can be used as accurate representations of global shape for recognition (accurate because globally computed). More important, we propose a technique that overcomes the unreliability of segmentations by averaging over all possible segmentations weighted by their probabilities. The average is computed in closed form based on simple approximations whose validity we verify a posteriori. Using this technique, we can match images directly according to the contained shapes without computing any actual segmentation. We apply this approach in tracking and in recognizing/localizing object categories.

Closing the loop, we also get new algorithms for segmentation and for edge-preserving smoothing. Instead of the "most likely" segmentation, our algorithm computes the "mean" segmentation of least variance. Minimizing the variance gives a more consistent and predictable segmentation, which is important when using this result for further processing. Our segmentation results are competitive. Noting the connection between segmentation and smoothing, we present a technique that smoothes according to the global image structures; previous methods only use the image's local coherence. We exploit the encoding of the global structures in the segmentation probabilities. Since our method doesn't rely on any single segmentation, it can smooth across as well as within segments.

A journal submission with Hongzhi Wang (Hongzhi Wang and JO, "A Global Contour Measure for Image Segmentation") contains a smaller but useful idea: that a good segmentation is distinguished by giving a much better organization of the image than any small perturbation of this segmentation. Experiments show that a sharp change in the organizing power of a bounding contour gives a better criterion in searching for good segmentations than the contour's organizing power itself. In a sense, this generalizes edge detection to the detection of sharp transitions in a global image characterization.

List of Papers

Book chapters

1. J. Oliensis and P. Dupuis, "Direct Method for Reconstructing Shape from Shading," in *Physics–Based Vision: Principles and Practice, Shape Inference Volume*, L. Wolff, S. Shafer, G. Healey, editors, Jones and Bartlett, Boston, June 1992, 17–28.

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3. J Oliensis and R. Hartley, "Iterative extensions of the Sturm/Triggs algorithm: convergence and nonconvergence," **IEEE Transactions on Pattern Analysis and Machine Intelligence**, 29:12 2217-2233, 2007.

4. J Oliensis, "The Least-Squares Error for Structure from Infinitesimal Motion," **International Journal of Computer Vision** Vol. 61, No. 3, 259–299, 2005.

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