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GEODESIC CONVOLUTIONAL SHAPE OPTIMIZATION

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Abstract: Aerodynamic shape optimization has many industrial applications. Existing methods, however, are so computationally demanding that typical engineering practices are to either simply try a limited number of hand-designed shapes or restrict oneself to shapes that can be parameterized using only few degrees of freedom.

In this talk, I will present a new way to optimize complex shapes fast and accurately. To this end, we train Geodesic Convolutional Neural Networks to emulate a fluid dynamics simulator. The key to making this approach practical is remeshing the original shape using a poly-cube map, which makes it possible to perform the computations on GPUs instead of CPUs. The neural net is then used to formulate an objective function that is differentiable with respect to the shape parameters, which can then be optimized using a gradient-based technique. This outperforms state-of-the-art methods by 5 to 20% for standard problems and, even more importantly, our approach applies to cases that previous methods cannot handle.



Pascal Fua received an engineering degree from Ecole Polytechnique, Paris, in 1984 and the Ph.D. degree in Computer Science from the University of Orsay in 1989. He joined EPFL (Swiss Federal Institute of Technology) in 1996 where he is now a Professor in the School of Computer and Communication Science. Before that, he worked at SRI International and at INRIA Sophia-Antipolis as a Computer Scientist. His research interests include shape modeling and motion recovery from images, analysis of microscopy images, and Augmented Reality. He has (co)authored over 300 publications in refereed journals and conferences. He is an IEEE Fellow and has been an Associate Editor of IEEE journal Transactions for Pattern Analysis and Machine Intelligence. He often serves as program committee member, area chair, and program chair of major vision conferences and has cofounded two spinoff companies.

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