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Human Faces - From Reality to Reality

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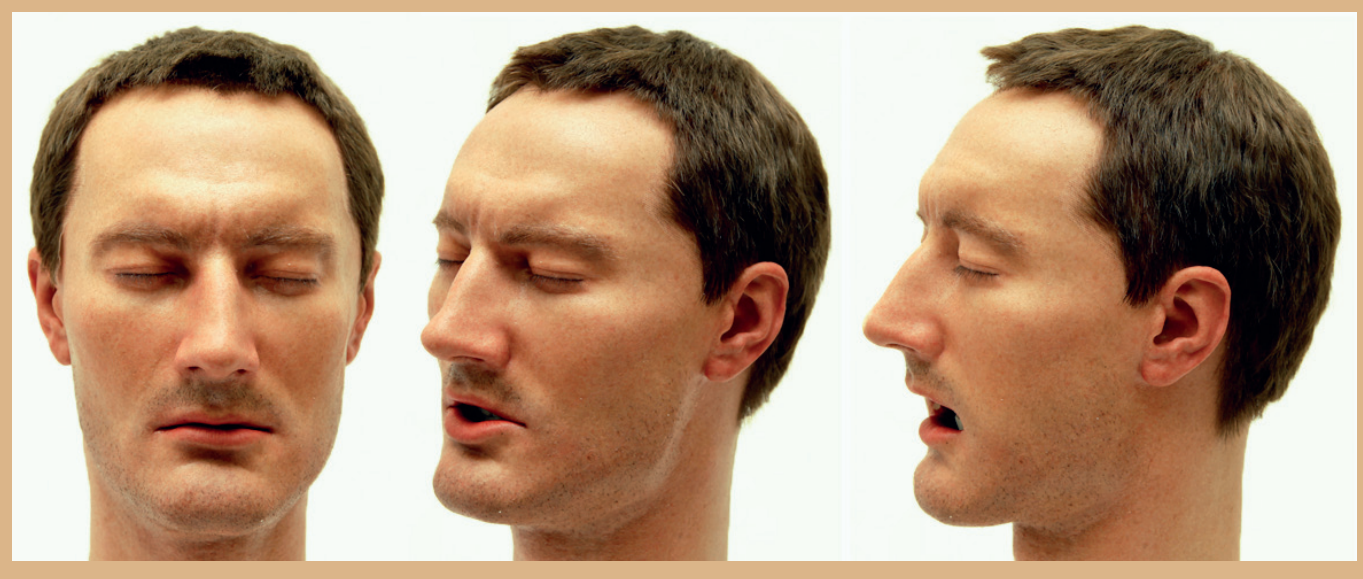
The human face plays a critical role in almost all aspects of human interaction and face-to-face communication. As such, face modeling has long been considered a grand challenge in the field of computer graphics. Realistic simulation behavior, surface details, and appearance are still demanding tasks.

In this talk, I will present on our recent research efforts in acquiring and modeling deformable materials, with a special focus on human faces. Furthermore, based on these techniques, I will talk about a data-driven process for designing and fabricating materials with desired deformation behavior using 3D printers, demonstrating our efforts to close the loop between the virtual and real world. In particular, I will present a passive stereo system for capturing the 3D geometry of a face in a single-shot under standard light sources and its extension to performance capture. The system is low-cost and easy to deploy. Results are sub-millimeter accurate, and the models meet the quality requirements of a demanding domain like the movie industry. Our primary technical contribution is a modification of standard stereo refinement methods to capture porescale geometry, using a qualitative approach that produces visually realistic results.

To close the loop between the virtual and real world, we also started investigating the inverse process of designing and fabricating materials with desired deformation behavior. The process starts with measuring deformation properties of base materials. Given these measurements, we use physics-based simulation to predict the behavior of a face made from these materials when it is driven by an underlying robotic actuation. As the key component of our process, we present a novel optimization scheme that determines the parameters of the synthetic skin as well as actuation parameters to best match a given set of example poses.



We finally demonstrate the complete process by designing and fabricating objects with complex heterogeneous materials using modern multi-material 3D printers as well as an attempt to physically cloning a real human face onto an animatronics figure.