

# Kraniofaziale Operationssimulation mit visuell - haptischer Integration

## Visuell and Haptic Integration in Craniofacial Surgery Simulation

Girod Sabine<sup>1</sup>, Daniel Morris<sup>2</sup>, Michael Meehan<sup>3</sup>, Fed Barbagli<sup>2</sup>, Calvin Maurer<sup>4</sup>,  
Ken Salisbury<sup>2</sup>

<sup>1</sup>Stanford University

Plastic and Reconstructive Surgery

<sup>2</sup>Computer Science Department, Stanford University

<sup>3</sup>Stanford Plastic Surgery

<sup>4</sup>Image Guidance Laboratory, Stanford University

The treatment of patients with complex facial deformities and fractures is one of the most challenging multidisciplinary tasks in medicine. Due to advancements in medical technology and surgical techniques in the last twenty years, surgical correction of severe malformations has become possible. Recent developments in 3D imaging techniques have already greatly facilitated diagnosis of complex craniofacial deformities. In the future, virtual environments will allow medical students to practice delicate operations and confirmed surgeons to learn new techniques and review procedures that are performed infrequently.

As a key step toward this goal, we have developed an environment for simulating craniofacial surgeries visually and haptically. CT or MR data can be loaded into the simulation environment, and a user can drill and manipulate skeletal anatomy using a variety of virtual tools, controlled with a force-feedback haptic device. Graphic, haptic, and auditory feedback is coordinated to provide a realistic sense of interaction with the virtual bone. Several aspects of relevant physiology are simulated, including the activity of sensitive nerves in the vicinity of potentially dangerous manipulations.

For simulation of osteosynthesis techniques, 3D models of several osteosynthesis plates are incorporated into the system. Using these industry standard plates, users can plan and practice operations using exact 3D models of both the patient and the hardware which will be used intraoperatively.