

FAKULTÄT FÜR INFORMATIK

Faculty of Informatics

Diplomarbeitspräsentation



Pose-Driven Generation and Optimization of Seating Furniture

Masterstudium:

Visual Computing

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Introduction

Problem Statement

Personalized furniture design is utilized to provide comfortable seating solutions for specific environments. Modern furniture design systems often depend on manual design effort.



Concepts

Pose-Driven Design

An environment is defined by a sitting pose and a body shape. A variety of motion captured poses and variable body shape models are useable as input.



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Contributions

- A computational design framework to generate personalized seating furniture models, for a large variety of sitting poses and body shapes.
- An automized multi-stage fitting and optimization process based on comfort and visual quality.

Sitting Comfort

An importance map is computed for a body model in a specific pose based on equal pressure distribution [1]. For optimal comfort, high importance areas require close fitting support by the seating surface.

Methods

1. Generic Template Model

A configurable seating surface model is defined to support a variety of body shapes and poses:

- The model is a two-dimensional grid of free floating planes.
- Each plane is assigned to specific body parts.

2. Surface Fitting

The individual planes of the model are fitted to their corresponding body parts' vertices according to their importance weights:

- An optimal plane is determined via a constrained RANSAC based fitting algorithm.
- A connected, non-planar, quadrilateral

3. Mesh Optimization

A local non-linear optimization step is applied to improve the visual quality of the model while maintaining its function.

- Planarity and regularity are utilized as visual quality measures.
- Functional quality is the closeness to the original planes from the fitting stage.



4. (Optional) Weighted Fitting

The created models are directly usable as control meshes for the weighted fitting algorithm by Leimer et al. [1] which further refines and fits the surface.

The generated control meshes replace manual design effort while preserving quality.

Results

- Seating surfaces are generated and optimized fully automatically. Average run time in MATLAB: 21.5s (Intel Core i7-4770K 3.5 GHz).
- Utilizing the generated meshes, the weighted fitting [1] framework can be automized to produce reliable results (bottom row).





▶ [1] Kurt Leimer, Michael Birsak, Florian Rist and Przemyslaw Musialski. 2018. Sit & relax: Interactive design of body-supporting surfaces. *Computer Graphics Forum. 37:349–359*

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