Customize garment pattern for made-to-measure

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Outline

• Introduction
• Prior work
• Garment customization method
• Experiments
• Summary
Introduction

My PHD Project

Body model → Adaptation → Preposition → Simulation → Made-to-Measure → Flatten → 2D garment → Flatten → Made-to-Measure → 3D garment

For Virtual Try on

For Manufacture
Problem statement

- **Input:**
  - 2D garment composed of 2D patterns
  - 3D body model
- **Output:**
  - 2D patterns suitable for input body
- **Goal**
  - According to measures of body
  - Less force and pressure of garment on body
Motivation

- Fit customer → made-to-measure

- Facilitate design procedure
- Manufacturing
Prior work

- **Developable surface based approach** [Huang12] [Meng12]
  - Input: body embed with features
  - Process: sketches of garment
  - Output: 3D garment surface + flattened 2D patterns
  - Drawbacks
    - Have to redesign for each body model
    - Difficult to locate darts and seams

Prior work

• **Transfer based approach** [Meng&Wang12][Brouet12]
  – Input: standard garment on reference body + target body
  – Output: transfer onto target body while optimizing shape features
  – Advantage:
    • Formulate 3D grading criteria
  – Disadvantage:
    • Not consider feature of 2D pattern

Challenges

• For developable surface modeling
  – Curvature = 0 → Non-linear
  – How to linearize developability optimization

• For manufacturing
  – Consider feature of 2D patterns
  – How to formulate 2D grading criteria
Proposed workflow

Input

Sketch features

Pre-fitting & Simulation

3D Garment customization

2D Pattern Flattening

Output
Pre-fitting & Simulation

• **Pre-fitting**
  – Extract measurements of body
  – Position patterns on body
  – Fitness evaluation
  – Roughly scale 2D patterns
    • Follow original design
    • Ready to suit for body

• **Simulation → an initial 3D garment surface**
3D customization

- Sketch some features
  - Tight part
  - Loose part
  - Feature curve
- Find a new 3D garment that
  - Interpolate sketched features
  - Preserve feature of 3D garment and 2D patterns
3D optimization for customization

- Optimize: \( \text{argmin} \left( w_S E_S + w_D E_D + w_B E_B + w_I E_I \right) \)

- Shape preservation
  - Laplacian

- Developability
  - Linearize using the property that normals on Gaussian sphere form a continuous curve

- Boundary
  - Boundary curves own similar 2\textsuperscript{nd} difference

- Fidelity
  - Interpolate features
2D Pattern flattening

- Apply ABF++\textsuperscript{[Sheffer05]} to obtain an initial guess.
- Perturb initial 2D patches to achieve:
  - Boundary smoothness
  - Lengths of seam pairs are equal
  - Adapt darts and seams if necessary
  - Consider material parameter

\textsuperscript{[Sheffer05]} Alla Sheffer et al. “ABF++: fast and robust angle based flattening”, TOG, 2005
Experiments

• **Evaluate**
  – Force: warp and weft (F/m)
  – Pressure of garment on body (F/m²)

• **Four cases:**
  – Skirt
  – Pant
  – T-shirt
  – Dress
Experiments (Case1: Skirt)

Original garment

Customization

Customized garment

Less force & Less pressure

Force  Pressure

Force  Pressure
Experiments (Case2: Pant)
Experiments (Case 3: T-shirt)
Experiments (Case 4: Dress)

Original garment

Customization

Customized garment
Summary

• A new formulation of garment pattern customization
  – 3D optimization model
  – New linearization strategy using the normal criterion of developable surfaces
  – More features considered

• On progress
  – 2D pattern flattening
  – Comparison with prior art
  – Comprehensive evaluation
Thank you!