



CADANS – Advanced digital  
technologies for the  
improvement and customization  
of wearable products

# **CADANS seminar 2015. Conclusions on R&D and valorization of enriched statistical body shape models**

*Stijn Verwulgen  
2 june 2015*

*Department of Product Development, Faculty of Design Sciences, University of Antwerp*



## **Items to be considered for valorization and further R&D**

1. Potential application domains
2. Data acquisition
3. Algorithms and mathematics
4. Enrichments
5. Tools and techniques for valorization
6. Collaborative research infrastructure



# Potential application domains I

- In the process of product development
  - Improved fit by true body mannikins
  - Improved ergonomics by taking account of true body shape and variation
  - Parametrization of body parts allows for parametrized design
  - Applications in the front-end, concept development and product life cycle e.g. deployment in point of sale and manufacturing
  - Enriched statistical shape models (ESSM's) might serve as a catalysator for the development of categories of new products including exoskeletons, robotics, incorporating wearables, sensors for monitoring body parameters and actuators.
- Manufacturing
  - Applications in CAD/CAM
  - Drivers for personalized production techniques especially due to parametrized models
  - Catalysator for incorporating shape memory materials and flexible molding
  - Facilitating online manufacturing



## Potential application domains II

- Apparel, Retail, Shoe trade and Fashion contain lead cases and might steer and benefit from further developments of enriched statistical shape models.
- Health care contains established applications in Orthopedics, Dentistry, Surgery, Prostheses. Potential new applications are contained in
  - Wellness and body management
  - Somatotyping
- Applications in Sports for:
  - Optimize performance
  - High end product development
  - Coaching
- Genetics, mapping genes to body form and conversely, identifying evolutionary traces.



# Data acquisition

- Opportunities in merging data captured by different media (Kinect, Smartphone, Medical images, body sensors,...).
- Challenges and opportunities in ambulant posture registration.
- ESSM's might can be used for data pre-processing techniques.
- Challenges and opportunities in the development of Data Standards for ESSM's.
  - Dynamic platform to anticipate on meta-data and enrichments
  - Development and implementation of a viable business model
  - taking account of licences and ownership
  - Development of quality control systems



# Algorithms and mathematics

- Opportunities in merging data captured by different media (Kinect, Smartphone, Medical images, body sensors,...).
- Challenges and opportunities in ambulant posture registration.
- ESSM's might can be used for data pre-processing techniques.
- Challenges and opportunities in the development of Data Standards for ESSM's.
  - Dynamic platform to anticipate on meta-data and enrichments
  - Development and implementation of a viable business model
  - taking account of licences and ownership
  - Development of quality control systems



# Data acquisition

- Need for approachable ESSM's, for example to compare delimited body parts, in function of the target product.
- Development of mathematical theories
  - to cope with limitless multitude of variations, for example rich enough to take account of evolutionary traces,
  - to cope with meta-data,
  - to cope with enriched models.
- Development of a framework to conduct statistical tests taking account of all data types.



# Enrichments I

- meta-data and big data
- modelling the interior, for example
  - ear channel, as is established by existing techniques
  - nasal cavity, which should be established by medical images
  - Modelling bones, organs, tissue, ..
- modelling physical and physiological parameters, such as already done with pressure distribution, forces and moments, heat transfer, ...
  - Further applications in e.g. resolution maps for vibrotactile perception, skin conductivity (to gain insight on wearable sensors)



## Enrichments II

- Strong challenges and opportunities in linking enriched shape models to motion:
  - generating articulating models joining skeletons and shape
  - modelling articulation by posture monitoring,
  - opportunities in mapping range of motion and motion patterns as a function of shape, building motion databases,
  - predicting motion by skeleton, shape and motion databases.
- Enriched models should be verified physically and digitally



## Need for tools and techniques for valorization of ESSM's.

- Systematic study of the deployment of ESSM's in the process of product development and entailed improvements, including appropriate verification.
- Opportunities in the development of CAD/CAM environments that contain current state of the art ESSM's and that can be dynamically completed with newly available data.
- Development of online tools for defining, manufacturing and selling body-related products.
- Development of demonstrator cases and tutorials.
- Usable measurement systems to determine fitting products in shopping context, online, pda based and in physical world shopping



# Need for collaborative research infrastructure I

- Imaging devices for body monitoring along state of the art gold standards in lab conditions
  - Skeleton bases,
  - 3D
  - 4D
- Outdoor measuring equipment
  - standard posture tracking equipment
  - plug and play wearable posture and motion tracking for outdoor application, extendable with sensors for physiological data
  - Inter-body parameters (eg personal distance) and interactions (e.g. registration if synchronism of a group of dancers, choreography registration)
  - relevant mechanical, electrical, optical, biochemical sensors



# Need for collaborative research infrastructure II

- Wearable sensors and actuators for motion management (e.g. vibro-tactile feedback) and optimizing (individual as well as groupwise optimization)
- Flexible databases, incorporated in a viable business model for
  - Motion
  - body shape models
  - Special challenge is to integrate medical data*
  - new databases comprising ESSM's
    - ✓Skeleton
    - ✓Somatotype-Shape
    - ✓Range of motion-Shape
    - ✓Movement patterns-Shape
- Current tools and techniques to translate data into products
- Tools for physical verification



## More information?

[Stijn.verwulgen@uantwerpen.be](mailto:Stijn.verwulgen@uantwerpen.be)

Product development

[Toon.Huysmans@uantwerpen.be](mailto:Toon.Huysmans@uantwerpen.be)

Iminds-Vision Lab

[Steven.truijen@uantwerpen.be](mailto:Steven.truijen@uantwerpen.be)

Kinesiology