Digital Human Models
Results of a World Café in Stuttgart on February 9, 2017

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Content

- Applications of digital human models
- Objectives of the use of digital human models
- Description dimensions of digital human models
- Literature and organisations
- Norms, guidelines, committees
- Results of the World Café „Digital Human Models“: Chances, driving forces and challenges sorted by different domains
Application classes 3D human models

- Digital design and testing of (technical) systems for human use (examples: usability, accessibility, visibility, comfort, safety, protection, crash, orthotics, prosthetics)

- Digital design and testing of technical systems taking into account the presence of humans: human as a physical influencing variable, for example in simulation models (Examples: crash, airflow cockpit, vibration analysis seat)

- Physical simulation of body functions (examples: forces, flow)

- Design, test, training of processes with the involvement of other actors/ avatars (examples: military training environments, emergency response simulators)

- Training and education on digital people (example: surgery)

- Virtual human as a trainer for the improvement of knowledge transfer

- Media, entertainment, infotainment, tele conferences
Areas of application

- Engineering: design workplaces, cockpit, work processes, tools, sports equipment, (protective) clothing
- Defense: training, battlefield simulation
- Medicine: training surgery, design implant with CT data, simulation as diagnostic support
- Fashion design
- Entertainment: games, film
- Education: digital trainers

Objectives and benefits 3D human models

- Avoidance of (accident/ life) danger
- Consideration of many age groups, percentiles, somatotypes in the system design: hedging product functionality for large part of the population is achievable
- Objective, repeatable statements about comfort
- Meaningful simulation results (physics) partially only possible taking a human model into account
- Realistic but risk-free military and medical simulators: better training effect
- Diagnostic support
- Simulation environments with avatars cheaper in the medium term than field exercises; independent of disturbing influences (like weather)
- Increase entertainment value, improve transfer
Description dimensions 3D human models

- Anthropometry
  - Anthropometry
  - Movement analyses
  - Body temperature analysis
- Biomechanics
  - Feasibility assessment
  - Posture analyses
  - Force analyses
- Physiology
  - Accessibility analyses
  - Stress analyses
  - Accident
- Cognition
  - Posture analyses
  - Force analyses
- Language
  - Comfort analyses
  - Perceiving
  - Problem solving
- Emotionality
  - View analyses
  - Deciding
  - Voice input
- Functional view
  - Learning
- Representation and visualization
- Level of detail
- Output system
- Time-related view
- Autonomy
- Individuality
- Human model
  - View analyses
- Level of autonomy
- Role description
- Desktop-based 3D illustration
  - Animation, manipulation
  - Keyframing
  - Proactivity
  - Conversation
- Immersive VR (graphic)
  - Parametric animation
  - Reactivity
  - Presentation
- Haptic
  - Inverse kinematics
  - Robustness
  - Assistance
- Whole-body model
  - Motion capturing
  - Adaptivity
  - Pedagogy
- Face model
  - Face animation
  - Cognition
  - Cultural aspects
- Garment model
  - Sociality
- Hair model
  - Lip synchronized speaking animation
- Anatomic model
  - Adaptivity
  - Pedagogy
  - Cultural aspects
- Output system
  - Autonomy
  - Individuality
- Time-related view
  - Role description
- Human model
  - View analyses
  - Level of autonomy
  - Role description
Literature

- Brechter, Matthias: Entwicklung einer Auswahlsystematik für digitale Menschmodelle. Masterthesis, Hochschule Reutlingen, 2010

Organisations

- SAE G-13 Committee on Digital Human Modelling Technology http://www.sae.org/standardsdev/aerospace/g13.htm
- IEA Technical Committee on Human Simulation and Virtual Environments (TC HSVE), http://www.iea.cc/about/technical.php?id=51deab500e62e
- International Society for Human Simulation http://www.societyhumansimulation.org/
Norms, guidelines, committees

- ISO 7250  Anthropometry / Essential dimensions of the human body for the technical design
- ISO 15535  General requirements for establishing anthropometric databases
- ISO 15536-1/-2  Ergonomics - Computer manikins and body templates
- ISO 13407  User-oriented design of interactive systems
- ISO 20685  3-D scanning methodologies for internationally compatible anthropometric databases
- ISO/IEC 19774  Information technology - Computer graphics and image processing – Humanoid Animation (H-Anim)
- DIN EN 547-1/3  Body measurements of humans
- VDI 3633-6  Simulation - Illustration of the personnel in simulation models
- VDI 4499 Part 4  Features and Limitations of Human Models, German Guideline
Results World Café: Market & Business models

**Chances**
- Planning
  - Cost-Benefit-Analysis
  - Human models in early warning systems, Collisions
- Virtual maintenance
- Cost reduction
  - Quality improvement
  - Quality assessment
    - Ergonomics
    - Specifications
    - Avoidance of errors / Hedging
  - Human-centred planning and development
  - Individualisation of human models
- Virtual commissioning
  - Simulation
    - Emergencies
    - Accidents
    - Rescue
  - Accident situation
  - Operator simulator
  - Training for employees
  - Validation of safety concepts
  - Workplace design without Mock-up
- Marketing
  - Product differentiation
  - Ergonomics as a label
- Business models / procedures
  - DMM as a service (planning, …)

**Driving forces**
- Individualisation
- Globalisation and cooperation
- Demands from applications
  - Occupational medicine
  - Safety at work
  - Product security
  - Workplace ergonomics
  - Corporate Governance
  - Continuous improvement process in shopfloor (efficiency, ergonomics)
  - Marketing
  - Doctor, training, fire brigade
  - Sport
  - Medicine: digital shadow, prosthetics, orthotics

**Barriers**
- Cost-benefit ratio of DMM unfavorable
- IT services insufficient
Results World Café: Processes & Procedures

Chances
- Prototyping
  - Integrations between trades/domains
  - Visualization for non-specialists
  - Communication between expert groups, also global
  - Human-centred (product, production)
  - Support decision making
  - Planning large integration projects
  - Process illustration
  - Flexibility and variability

Driving forces
- Processes
  - Development costs
  - Avoidance of errors
  - Increase of cost efficiency
  - Crowd engineering
  - Simultaneous engineering
  - Concurrent engineering
- Digital hedging
  - Human factor, human centered design/engineering
  - Hedging for world markets
  - Catastrophe simulation

Barriers
- Specialised DMM: lack of generic models
- No intuitive use of DMM-software
Results World Café: Technologies

**Chances**
- Prosthetics, Orthotics,
- Sports equipment
- Exoskeletons
- Vehicle construction
- Production systems

**Driving forces**
- Consumer technologies
  - Game engines
  - VR, AR, HMDs
  - VR controller
  - Cinema
  - Social media
- Human-robot-cooperation
  - Autonomous driving
  - Assistance systems
  - Machine learning
  - Exoskeletons
- Markerless tracking
- HPC, Cloud, Computing Power in general

**Barriers**
- Insufficient standardisation/ interfaces
- Lack of a standardised gesture language
- No integration in standard software
- Problem when mapping DMM and MoCap models
- Insufficient linkage, bandwidth infrastructure
Results World Café: Data availability

**Chances**
- Individualisation of human models
- Variety can be displayed

**Driving forces**
- Avoidance of privacy issue, as there are no real persons

**Barriers**
- Semantics of data (environment of DMM) (lack of standards)
Results World Café: Qualifications

Chances
- Transfer of knowledge in virtual space, learning applications
- Training for employees
- Manual substitution
- Rehab applications
- Medical questions
- e.g. Mixed Reality with dummy

Driving forces
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Barriers
- Lack of experts DMM
- Complexity of DMM software
- Lack of imagination for application possibilities
Results World Café: Society

**Chances**
- Communication between expert groups in prototyping, also global
- Human-centred planning and development
- Individualisation of human models

**Driving forces**
- Increase acceptance of collaborations
- Ageing society and demographic change
- More spare time

**Barriers**
- Lack of acceptance of DMM
- Employees, works council and generations
- Confidence
- Comparability
- Transparency and reproducibility of results
- Validation
- Data protection
- Visualization
Results World Café: Law & Politics

**Chances**
- Validation of safety concepts

**Driving forces**
- Admission and demand for virtual certification by legislator
- Avoiding privacy issues when using DMM as there are no real (natural) persons

**Barriers**
- Lack of subsidies (invest) incl. start-up funding
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