virtual humans:
a future design method

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represented humans

the body in the floor plan of a church, Francesco di Giorgio Martini (c. 1492)
introduction

represented humans

a metropolitan cathedral, Étienne-Louis Boullée (1972)
represented humans
introduction

represented humans

the suspended garden of an apartment, Le Corbusier (1928-1929)
represented humans
introduction

“I think it’s one of the things that is part of the criticism about the way that architects are trained – they don’t have a complex body in mind when they’re designing.”

“I don’t know about other peoples’ work but you never see the human form on any of our drawing whether they’re on the board or through the computer. I mean it’s all assumed.”

from an interview with an architect (Imrie, 2003)

“architects’ design for stereotypical people will utilize space in a predetermined way...diminish the polychromatic and three-dimensional qualities of the whole architectural experience.”

Bloomer and Moore (1997)
introduction

rational model of humans

body and mind distinction, Descartes, Rene (1650)
introduction

virtual humans
introduction
virtual body
artificial mind
introduction

avatars

anthropomorphic virtual body, controlled by human users
immersion and presence
direct-experience evaluation method
introduction

virtual users

autonomous agents, controlled by artificial perception and intelligence
probable phenomena generation
simulation method

computing physical and semantic properties of building object and VUsers (Hong. S., Technion-Israel Institute of Technology, 2014)
analytical and observational representation
an example of analytical and observable representation (Hong. et al., 2016)
introduction

humanoids

physical body controlled by computing

Darwin-OP Humanoid Research Robot (Robotis)
empirical applicability of virtual humans for architectural design
method

course applications

interview and survey

✔ types of design projects
✔ application ranges
✔ contents of discoveries and learnings
✔ enablers and barriers

✔ 4 courses in Inha University
digital design media 1, 2
advanced architectural design
BIM design and construction
human behavior simulation
empirical applicability and effects of virtual body

exploratory matches between physical properties and meanings

- inverse kinematics of avatars responding to parameters of physical objects
- exploring possible meanings of building objects
- experimenting subtle variations of curves

pavilion project (Han, J., 2016, digital design media 1, Inha University)
empirical applicability and effects of virtual body

pavilion project (Han, J., 2016, digital design media 1, Inha University)
empirical applications and effects of virtual body

pavilion project (Han, J., 2016, digital design media 1, Inha University)
empirical applications and effects of virtual body

pavilion project (Lee, D., digital design media 1, 2016, Inha University)
empirical applications and effects of virtual body

pavilion project (Lee, D., digital design media 1, 2016, Inha University)
empirical applications and effects of virtual body

creative collaboration

- shared semantics of not-yet completed objects
- co-examination and evaluation
- co-manipulation and mutual referring
empirical applications and effects of virtual body
perceptional cues in stereoscopic virtual-reality

✓ qualitative evaluation on parametric design methods
✓ sensitive to detect performances of generated patterns

parametric façade project (digital design media 2, 2016, Inha University)
empirical applications and effects
empirical applications and effects of artificial mind

quantitative analysis on human factors

- examining hypothetical relationship between parameters of physical properties and human behaviors
- measuring variations of socio-psychological factors under what-if contexts
empirical applications and effects of artificial mind

library project (Kim, W., advanced digital design, 2016, Inha University)
empirical applications and effects of artificial mind

dapdong cathedral project (Lee, H., advanced digital design, 2016, Inha University)
empirical applications and effects of artificial mind

hochang archive project (Oh, S., 2016, Inha University)
Area A (library open space) to area C (building entrance)

<table>
<thead>
<tr>
<th>Area A</th>
<th>Types of Events (Personnel)</th>
<th>Bottle Neck</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>rest (sitting)</td>
<td>Access</td>
</tr>
<tr>
<td>(form I)</td>
<td>0 p (not available due to slope-wall angle)</td>
<td>non-elder: 82 p, elder: 52 p</td>
</tr>
<tr>
<td>radius ( r = 40 ) mm</td>
<td>42 p</td>
<td></td>
</tr>
</tbody>
</table>

| (form I + stack & extrusion) | 60 p | 84 p | non-elder: 60 p, elder: 60 p |
| radius \( r = 40 \) mm, voxel container \( V = 400 \) mm |

| (form II) | 0 p (not available due to slope-wall angle) | non-elder: 82 p, elder: 52 p |
| radius \( r = 23 \) mm |

| (form II + stack & extrusion) | 60 p | 84 p | non-elder: 60 p, elder: 60 p |
| radius \( r = 23 \) mm, voxel container \( V = 400 \) mm |

Hochang Archive Project (Oh, S., 2016, Inha University)
empirical applications and effects of artificial mind
empirical applications and effects of artificial mind

alternative research method

- applied for a graduate students’ research method course
- application ranges: social model development in evacuation, fire egress, probable rituals in historical buildings, aesthetic arousal, shop zoning, etc.

social model in flood evacuation simulation (Kim, Y., human behavior simulation (G), 2016, Inha University)
empirical applications and effects of artificial mind.

fire egress simulation (Lee, H., human behavior simulation (G), 2016, Inha University)
virtual humans

- exploratory matches between physical properties and meanings
- creative collaboration and collective decision-making
- perception cues in stereoscopic virtual reality
- quantitative analysis on human and social factors
- experimentations to conduct variables in hypotheses

future research

- virtual human-applied automatic synthesis
- humanoids as a methodological means
- mixed use of direct-experience and simulation methods
- body-aided semantics to improve AI models
- interoperability between BIM and human behavior simulation
thank you