Towards the Automated Construction of Digital Cities

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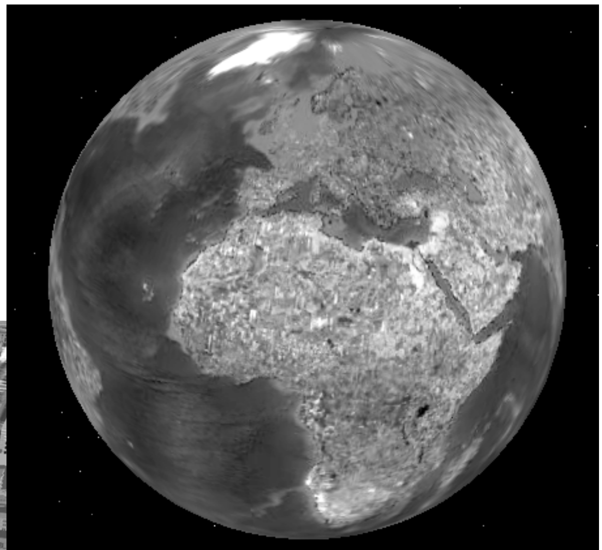
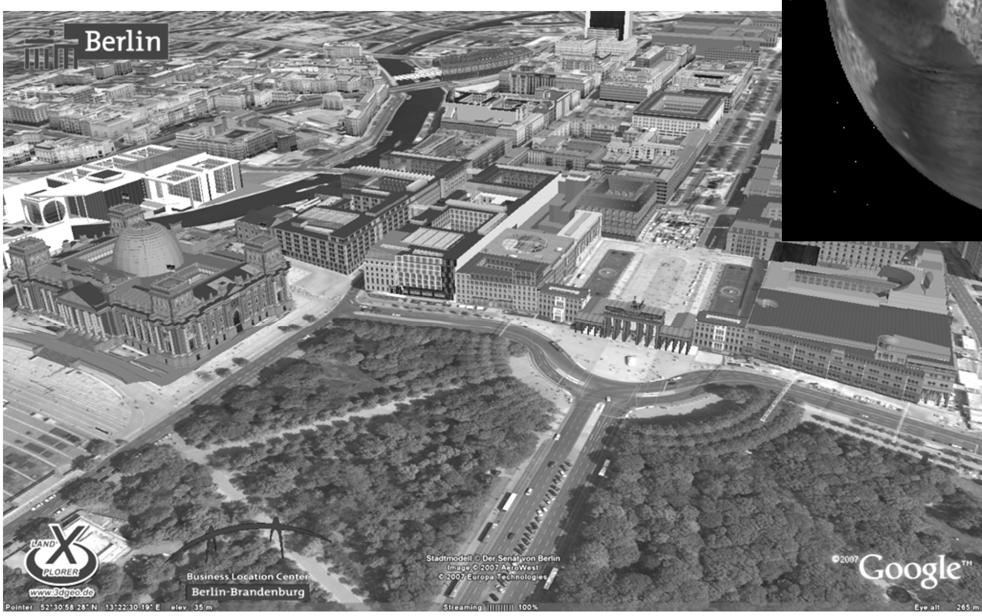
3D Geospatial Models

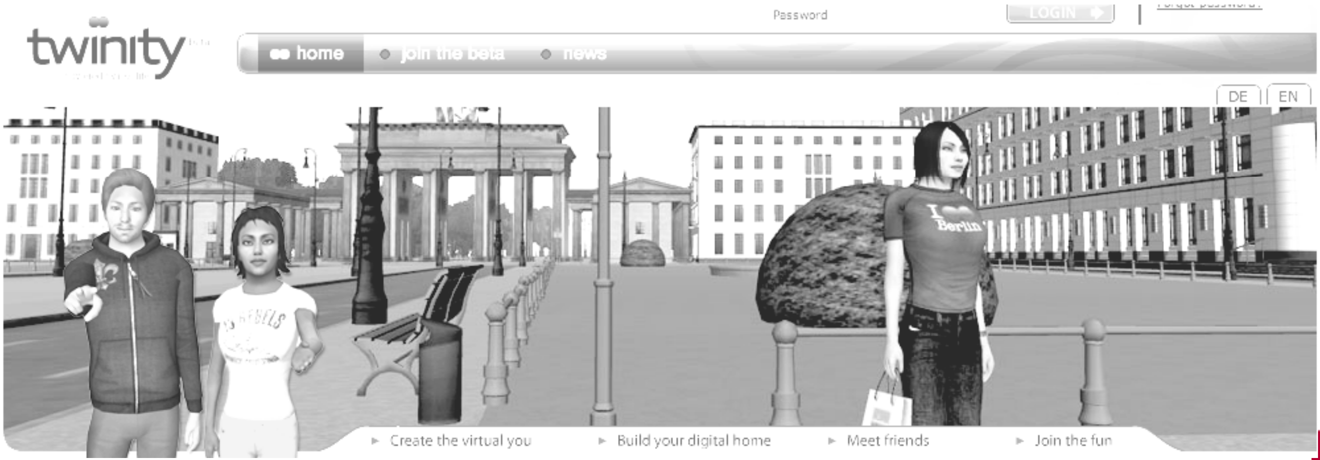
- Virtual globes
- Virtual regional models
- Virtual landscape models
- Virtual city models





3D Geospatial Models as Mainstream Technology

- Reaching the realm of end-users:
  - Google Earth/Maps,
  - Virtual Earth/bing,
  - SecondLife,
  - Twinity,
  - ...
- Example: Twinity – an online platform using a 3D geospatial model based on real-world street and building data



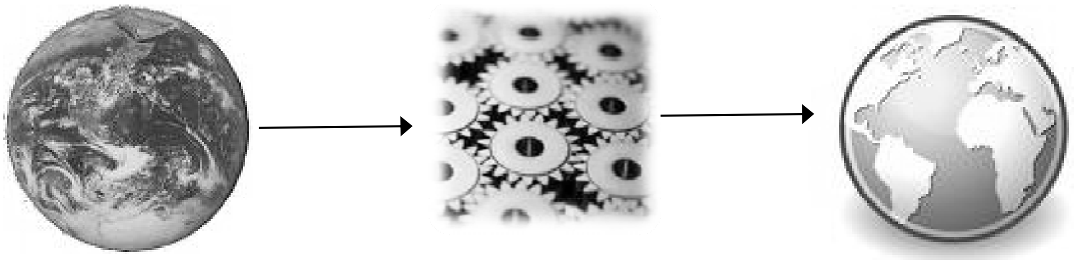
3D Geospatial Models as Integration Frameworks

- Represent spatial objects, structures, relations, processes, and phenomena
- Basic components are described by geometry, topology, appearance, and semantics
- Enable fusion of complex, heterogeneous, distributed geodata and georeferenced data at the visualization stage
- *Geovirtual 3D environments* represent uniform, general-purpose frameworks for seamlessly integrating and effectively using complex geoinformation
- Enable *holostic understanding* of complex spatial and spatio-temporal phenomena by means of visualization

Towards Automated, Computational Techniques

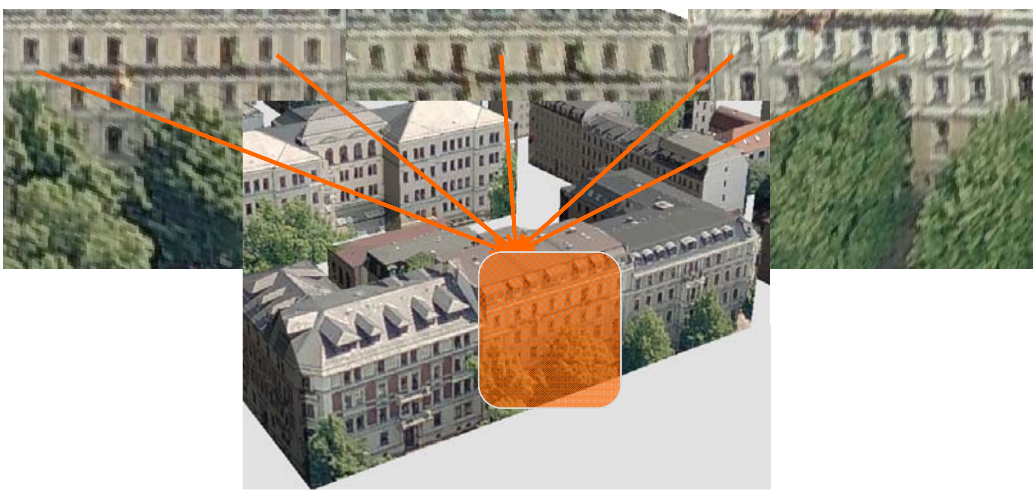
Various constraints/conditions need to be fulfilled:

- Topological data with defined relations to geometry data
- Geometry data with defined quality (precision, degenerations, meshing, ...)
- Semantics with defined relations to geometry and topology
- Multiresolution and homogeneous level-of-detail management
- ...



Surface Texture Synthesis based on Pictometry Data

- Pictometry delivers highly redundant aerial visual information
- Information can be used to synthesize completely new pseudo-photographs for almost all surfaces of a geovirtual 3D environment
- Principle:
  - For a given surface, consider a subset of potentially relevant oblique images
  - For each surface fragment, determine the best source, taking into account resolution and distance to an oblique image and occlusion by scene elements



Surface Texture Synthesis based on Pictometry Data

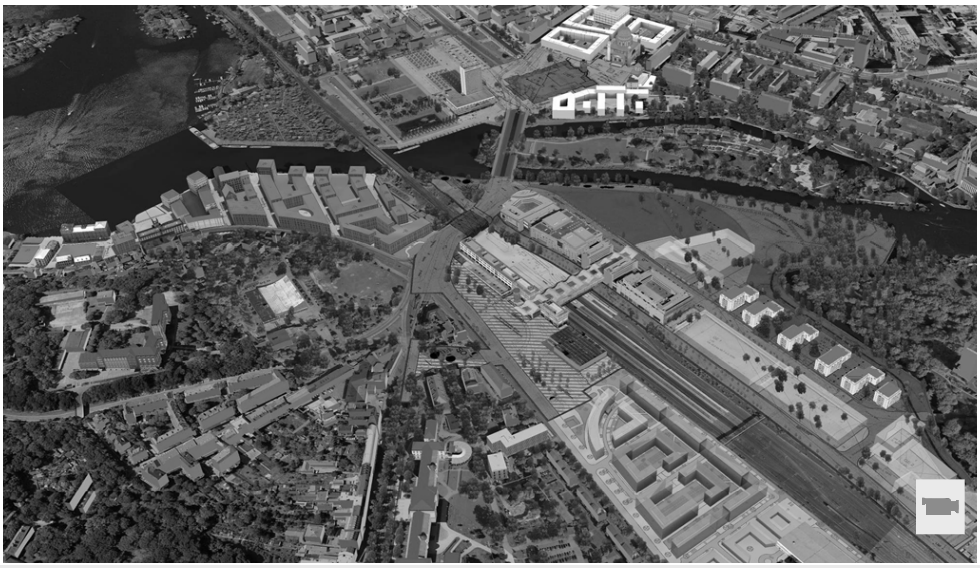
- Oblique images cannot reach all parts of all surfaces to a sufficient degree (or at all)
- Error metrics ensures that those areas can be identified

Surface Texture Synthesis based on Pictometry Data

- Example: 3D Model of Leipzig, Germany, textures are automatically produced (without any manual modeling) based on Pictometry datasets

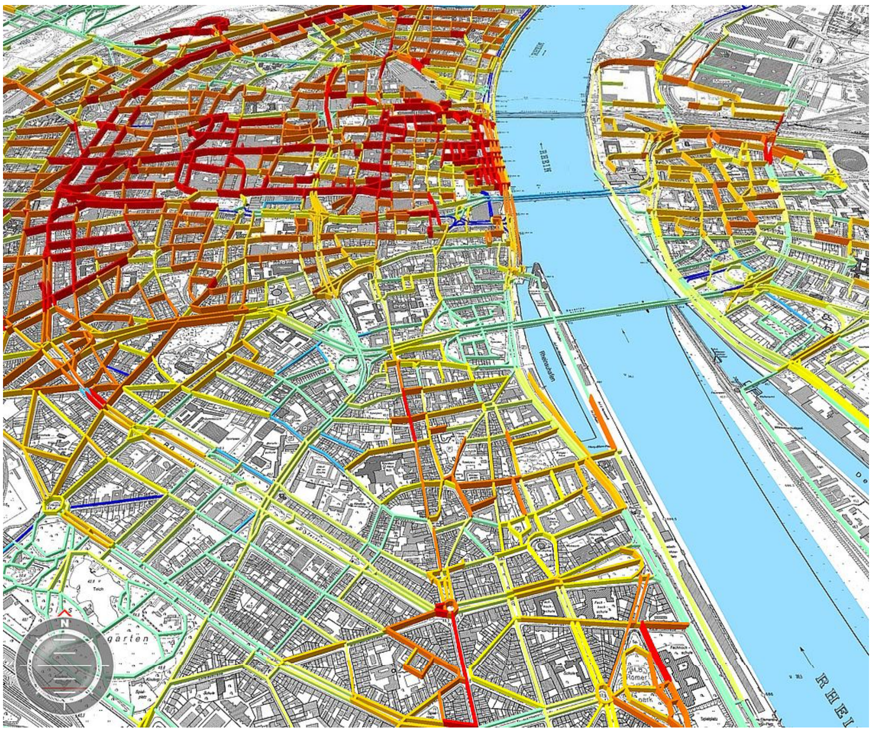
Characteristics of Geovirtual 3D Environments

- Mainly composed of CAD/GIS/BIM data
- Successful media for communicating geospatial information
- Support of naïve geography
- Intuitive and effective user interfaces
- System component in complex workflows
  in a growing number of application domains



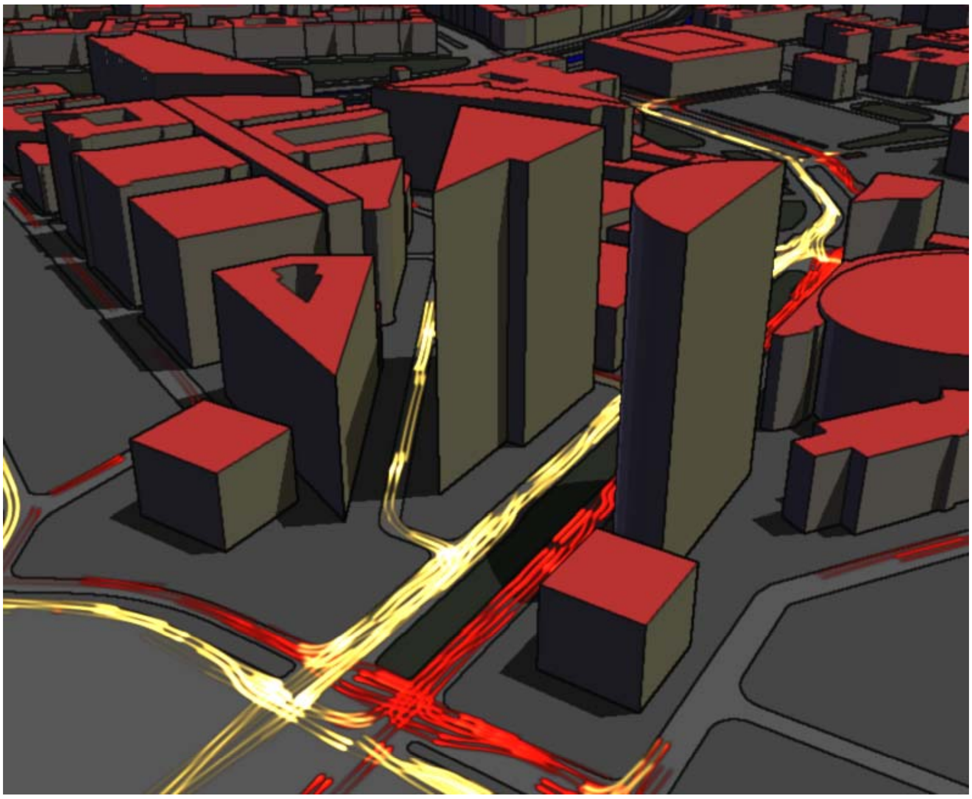
Integrating Georeferenced Information

- GeoVEs serve as tools to seamlessly integrate georeferenced information using the underlying 3D geospatial model as general-purpose reference surface and scenery
- Example: frequency of pedestrians & car drivers along major roads



Integrating Georeferenced Information

- Example: visualization of traffic activity by static glyphs

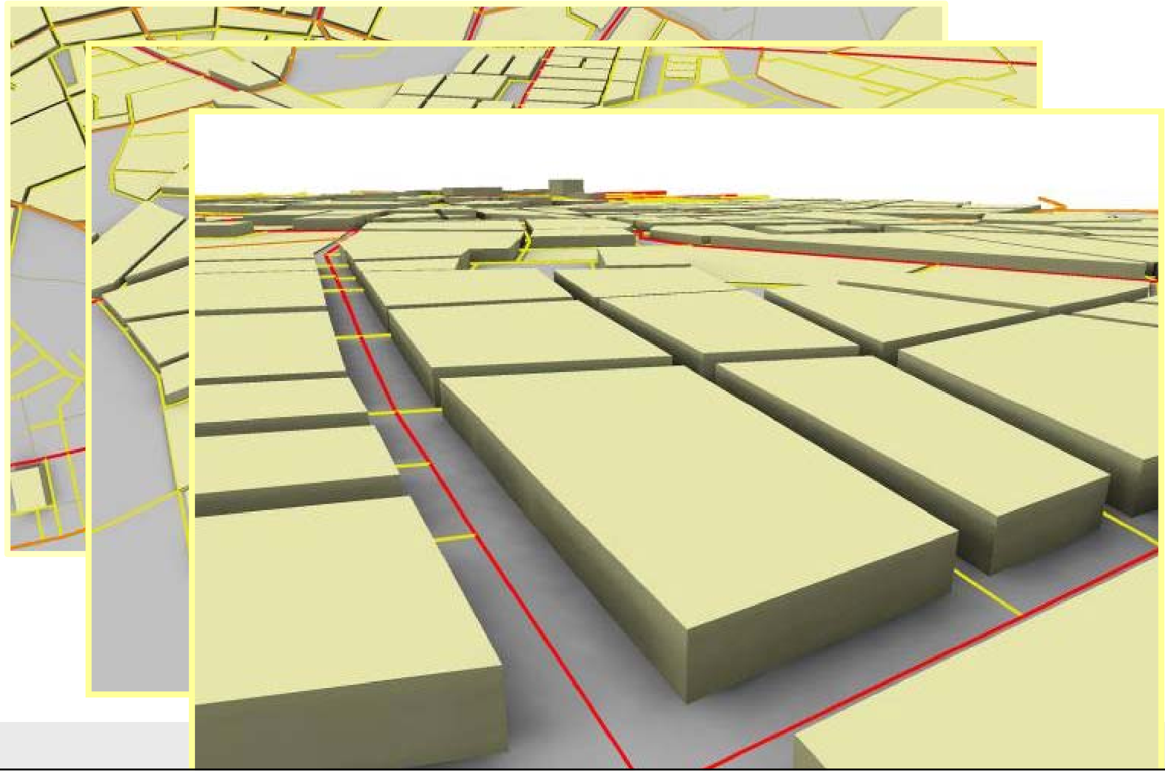


Integrating Georeferenced Information

- Example: Visual spatial data mining

Generalizing 3D Geospatial Models

- Goal: Reducing the complexity of detailed, high-resolution 3D models
- Approach: (1) Defining cell structures, (2) generalizing cell contents, (3) outliner management



Generalizing 3D Geospatial Models

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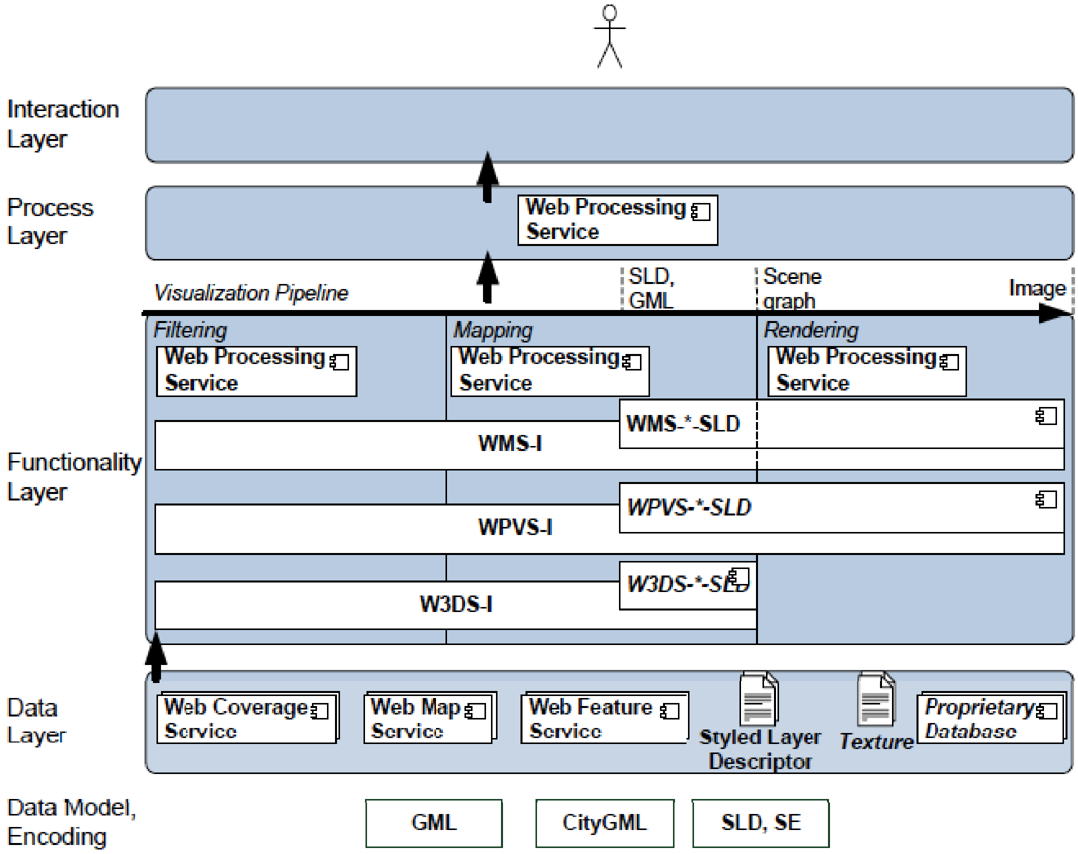
Generalizing 3D Geospatial Models

- Generalized 3D models are required to provide simulation and analysis systems a uniform, homogeneous access to geospatial data

4 Automated Generalization of 3D Contents

Generalizing 3D Geospatial Models

SOA Paradigm to Construct Complex Systems



5 Service-Based Systems and Applications

SOA Paradigm to Construct Complex Systems

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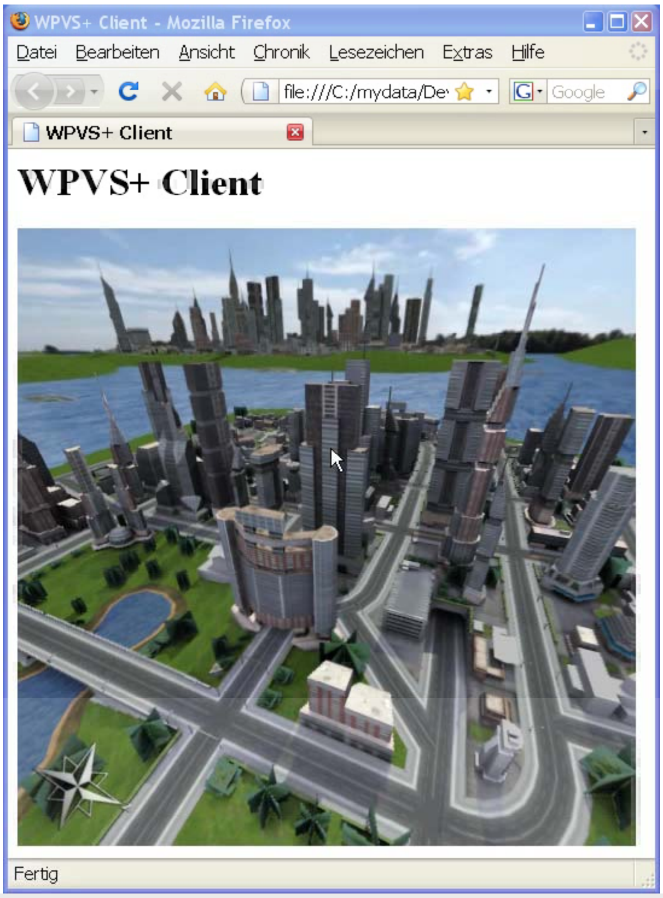

UI for Non-Desktop-Applications/Systems

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Publictions and projects, see

www.hpi3d.de

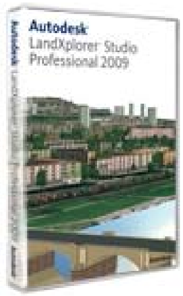
Background

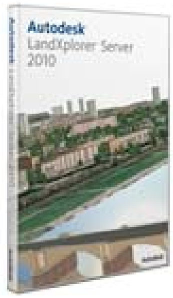
Research Topics

- Computer Graphics & Real-Time Rendering
- Visualization & Information Visualization
- Geovisualization

Hasso-Plattner-Institute

- University of Potsdam
- Studies in IT Systems Engineering
- 80+60 students accepted each year
- Privately founded research institute





Computer Graphics Division

- Started in 2001
- Dedicated research unit “3D Geoinformation” (2007-2011)
- Jointed research with major companies
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Contributions for 3D Geovirtual Environment Technology

A few main areas that contribute: (incomplete, unordered)

- Photogrammetry
- Geography
- Engineering/Archicture/Design
- Botany/Environmental Sciences
- Cartography

- Computer Graphics
- Scientific Visualization
- Databases
- Service-Oriented Systems
- WWW