3D Visualization and Decision-Making: Applications for the University of Southern California

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Outline

- Context
- Initial goal – Planning and visualizing 3D routes
  - CityEngine and CGA shape grammar
- Workflow
  - 3D modeling of indoor spaces
  - 3D network and route finding
- Example
- New student projects
- Closing comments

Core elements for 3D indoor routing applications
Context
Planning and visualizing 3D routes (2013-2015)

- With the increasing size and complexity of modern buildings, 3D indoor routing is receiving more attention nowadays.
- We generated 3D indoor and building models from CAD files and building footprints using CityEngine and its built-in procedural modelling approach.
- An Americans with Disabilities Act (ADA) compatible 3D network was created by combining 3D floor lines and transitions such as staircases and elevators.
- The resulting routes as well as the indoor and façade models were then visualized through a 3D WebScene generated by CityEngine.
CityEngine and CGA shape grammar

(a-c) Three examples of building façade models generated with CGA shape grammar; and (d) a CGA-generated 3D model of the Parkside Apartments at USC

CGA – Computer generated architectures shape grammar for procedural modeling (Muller et al., 2006)

LoD – Level of Detail
Overall workflow

3D modeling of indoor spaces
- Extraction of principal features
- Generation of 3D indoor models

3D network and route finding
- Construction of 3D network
- Best route finding
3D modeling of indoor spaces – extraction of principal features

Extraction of principal features, with sketches of: (a) the input CAD file; (b) the extracted polygons (color-coded with their usage type); and (c) the wall polygons

Geometry + Attributes
Generation of 3D indoor models: (a) 3D indoor model; and (b) CGA-generated elevator and staircase
3D visualization

Generation of 3D indoor models (2)

3D staircase model: (a) Staircase in the CAD file; (b) CGA-generated 3D staircase model
3D network and route finding

Construction of 3D network:
(a) 2D floor lines (blue) and staircases (red); (b) Completed 3D multimodal network; and (c) Zoomed-in view
3D network and route finding (2)

Different routing results: (a) without PREFERENCE; and (b) with PREFERENCE
Best route finding

3D route-finding task in ArcScene:
(a) Geoprocessing model; and (b) Resulting route visualized with 3D indoor model
Examples of 3D routing visualization: (a) and (b) ADA-restricted route to SSI
Examples of 3D routing visualization: (c) and (d) ADA-compatible route to SSI
Examples of 3D routing visualization (3)

Examples of 3D routing visualization: (e) and (f) ADA-compatible route inside AHF building
New student projects – Hardscape elements

CityEngine extrusion and addition of textures: Shumway Fountain
New student projects – Hardscape elements (2)

Constructing bowl for Shumway Fountain. Exported 3D object placed onto completed base and water within CityEngine
New student projects – Ground cover

Modeling trees with regression equations by species (n = 200-600) to achieve varied sizes
Challenges

- Esri’s constantly changing and evolving technology protocols and platforms on which this kind of work is performed and displayed
  - CityEngine
  - ArcGIS Pro
- Steadily increasing numbers of competing technology options, which are also constantly changing and evolving
- Constantly changing and evolving expectations on the part of current and potential new users as well
**Build Flexible Scenarios Faster**

Compare and analyze building proposals from every angle. See how they fit into your city’s overall vision for the future. Make as many scenarios as you need and add modifications.

**Create Realistic Context**

See where a proposed building blocks the view, casts shadows, and reflects heat. By making the virtual 3D visualization as real as possible in the design phase, you will avoid costly mistakes in the building phase.

**Share Your Urban Plan**

Publish your 3D model online. Others can interact with it, understand your urban plan, and participate in improving their community.

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**Rationale is straightforward**

**Requires substantial and varied skills**

**Short shelf life**

**Need to continuously update skills**
Introducing *Esri Ten For*, a new video series on GeoNet where you can ask our experts anything. For each video our expert will select ten of your questions and answer them to their best ability.

First up is “Ten For a 3D Engineer” with **Nathan Shephard**. Nathan is originally from Bridgetown, Western Australia and has been working at Esri since 1999. He works on the Desktop Software Development Team and specializes in 3D GIS. He is also the inventor of Pixzel Puzzles, “the world’s toughest word search puzzle game.”