xeokit

a Web Programming Toolkit for BIM & Engineering Graphics

WebGL Meetup, 18 November, 2020

https://slides.com/xeolabs/xeokit-sdk

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1. What is BIM?

- Building Information Modeling
- Digitized construction management
- Centered around a meta model, provided by the Industry Foundation Classes (IFC)
- Use models to collaborate on planning, design, construction and maintenance
2. WebGL BIM Challenges

- Load large models quickly
- Fit large models in browser memory
- Draw many objects, interactively
- Navigate precisely, in both open and tight spaces
- Accurately render full-precision geometry
3. What is xeokit?

- A JavaScript SDK for developing model viewers for BIM and engineering
- Uses WebGL
- Loads and views big models, at full-precision
- Loads IFC, glTF, OBJ, STL, 3DXML, XKT & metadata to classify objects
- Convert models with open source tools & host them on your own server

```javascript
const viewer = new Viewer({
    canvasId: "myCanvas"
});

viewer.camera.eye = [0,0,10];
viewer.camera.look = [0,0,0];
viewer.camera.up = [-0, 1, 0];

const xktLoader = new XKTLoaderPlugin(viewer);

const model = xktLoader.load({
    src: "myModel.xkt",
    metaModelSrc: "myModel.json"
});
```
5. Loading Big Models Quickly

- xeokit has a native, binary geometry format called "XKT"
- Quantized, tiled RTC vertex positions & oct-encoded normals
- 48 bits per position, 16 bits per normal
- Pre-computed wireframe indices
- Convert IFC to XKT using open source CLI tools
6. Converting IFC Models for xeokit

- Open source CLI conversion tools
- [github.com/xeokit/xeokit-sdk/wiki/Creating-Files-for-Offline-BIM](https://github.com/xeokit/xeokit-sdk/wiki/Creating-Files-for-Offline-BIM)
7. Loading IFC Models into xeokit

Minimal example

```javascript
import {Viewer} from "../src/viewer/Viewer.js";
import {XKTLoaderPlugin} from "../src/plugins/XKTLoaderPlugin/XKTLoaderPlugin.js";

const viewer = new Viewer({
  canvasId: "myCanvas"
});

viewer.camera.eye = [1842022, 10, -5173301];
viewer.camera.look = [1842022, 10, -5173401];
viewer.camera.up = [-0.0, 1.0, 0.0];

const xktLoader = new XKTLoaderPlugin(viewer);

const model = xktLoader.load({
  metaModelSrc: "metadata.json",
  src: "geometry.xkt"
});
```

[xeokit.github.io/xeokit-sdk/examples/#loading_XKT_Schependomlaan](xeokit.github.io/xeokit-sdk/examples/#loading_XKT_Schependomlaan)
8. Minimizing Memory Footprint

- xeokit stores geometry on the GPU, not in browser
- Quantized RTC vertex positions, oct-encoded normals
- 48 bits per double-precision position, 16 bits per normal

A large plumbing model at BIMData.io
9. Drawing Many Objects Interactively

xeokit uses two rendering techniques:

1. ANGLE_instance_arrays
2. Batched Geometry Arrays

- Combine single-use geometries into a single set of VBOs
- Add an array of per-vertex flags, to hold object states
- Vertex shader "discards" vertex when visible flag false
- Update all vertex flags for an object to set its visibility
10. Accurate Rendering - Rounding Jitter on WebGL

- Many BIM models use double-precision coordinates
- GPUs are usually only single-precision, however
- Need to emulate double-precision rendering to eliminate rounding jitter

Model centered at (1842022, 10, -5173301), provided by BIMData.io
11. Accurate Rendering - Eliminating Rounding Jitter

- Tiled, relative-to-center (RTC) coordinates
- Coords are 32-bit offsets from their 64-bit tile centers, rendered using modified view matrix
- Memory bonus: full-precision without the cost of storing double-precision values

Read about RTC coordinates in virtualglobebook.com

xeokit.github.io/xeokit-sdk/examples/#loading_XKT_jitter_fullPrecision_MAP
12. Navigating Precisely

- Distance-proportional rate of forward/backward movement
- Move fast in open spaces, move slow in tighter spaces
- Ray-cast every $n$ frames to find distance to nearest object, scale dolly and zoom rates accordingly

[Image: xeokit.github.io/xeokit-sdk/examples/#CameraControl_orbit_HolterTower]
13. xeokit in the Wild : OpenProject GmbH

- View multiple models
- Share issues via BCF
- Slice, highlight, X-ray
- Plan views

https://youtube.com/watch?v=qOTdYnWz_YA

github.com/xeokit/xeokit-bim-viewer

openproject.org/openproject-bim-10-4
Thanks!

- xeokit.io
- github.com/xeokit/xeokit-sdk
- xeokit.github.io/xeokit-sdk/examples/

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