Gesture-based Interactive Visualization of Large-Scale Data using GPU and Latest Web Technologies

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We are generating data on a petabyte scale through observations and modeling.

Data contains valuable information that can drive insights, innovations, and discoveries.

Data can be difficult to access and digest.

Visualization can help us pair science and design to simplify the complexity, and drive a deeper understanding of the context.
Visualization is an important tool

- analyzing and presenting large scale spatial and temporal data from environmental simulations and observations

- identifying the underlying properties in the data such as patterns and statistical relations between the variables

- communicating research results to decision makers and to the general public in an easily-understandable way
Trends in Scientific Visualization

- Web-based platforms (HTML5)
- Universal access (pc, smartphone, tablet)
- Interactive & self-service environments
- Rich and high-resolution visuals (2D/3D)
- Virtual & Augmented Reality (camera, marker detection)
- Immersive Reality (heads-up display, motion tracking)
- New ways to interact with the data (gestures, motion tracking)
- Gamification features (competition, social, achievements)
- GPU acceleration (WebGL, WebCL)
Concepts & Examples
2D Flood Simulator Game

Animation

Gamification

Scores
Your Best:
12.9 sq mi

Last Score:
12.9 sq mi

You saved 12.9 sq miles of the city from flooding.

Good job!
DYNAMIC DATA
HIGH-RESOLUTION STREAM FLOW VISUALIZATION
The Iowa Flood Information System (IFIS) is a one-stop web platform to access community-based flood conditions, forecasts, visualizations, inundation maps, and flood-related data, information, and applications.
FLOOD MAP FLIGHT SIMULATOR

3-DIMENSIONAL
REMOTE INTERACTION
Rainfall Data Visualization
Radar and Satellite-based Rainfall Visualization

- 7 NEXRAD radars for Iowa
  - XPOL, NPOL, D3R, MRM, etc.
- Processing 30Gb/day (NEXRAD)
- 1 Volume Scan (~ 30 million triangles)
- RHI, AHI scans (volumetric slices)
- Historical Data (2002-2014)
Date: Thursday, 6/12/08 5:30 am

Event: Storm on June 11

Speed: Normal
GPU Acceleration on the Web

Parallel Processing – Multicore GPU

Image / Video Processing

Data Analytics

Interactive Interfaces

Desktop-like Games

Web Technologies

NVIDIA Tesla K40 – 2880 CUDA Cores

4.29 TFLOPs Single Precision compute power
- HTML5, CSS, JavaScript, WebRTC
- WebGL (Web Graphics Library) – GPU accelerated graphics
- Augmented Reality Libraries – marker tracking and detection
- Immersive Reality – head tracking
- Physics Engine – collision detection
- Gesture / Motion Interaction
Technology

- HTML5, JS, CSS, WebRTC, Canvas
- WebGL (Three.js, Babylon.js)
- Augmented Reality (JS-Aruco, JSARToolkit, AREL, Tracking.js)
- Immersive Reality (Oculus Bridge, vr.js, Rift Effect, Cupola VR)
- Physics Engine (PhysicsJS, Box2DJS, Ammo.js, Cannon.js)
- Gesture / Motion Interaction (LeapJS, KinectJS, DepthJS, JS-NFT)
Controls and Interaction

Motion Tracking

Gesture Tracking

Remote Interaction

Infrared projector and sensor

VGA Camera

Microphone array

Motorised tilt

Remote Interaction
Augmented Projection

Marker

Table

Augmented Reality

Marker Detection

Augmented Reality
AUGMENTED REALITY
Thank you

Questions

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