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# Simulating Floods in Virtual Reality Byron Tasseff & David Judi

June 17, 2014

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# Energy and Infrastructure Analysis @ LANL

- Increase security of the nation's infrastructure
  - Electric power
  - Transportation (e.g. roads)
  - Telecommunications
  - Water
    - Water resource planning
    - Urban water and wastewater
    - Hydroelectric power
    - Water hazards and fast response





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#### **Surface Water Model**

- 2D shallow water equations
  - Multiple scales (urban, regional)
  - Easily use with gridded datasets
- Distributed hydrologic models
  - Rainfall
  - Infiltration
  - Surface friction





### **GPU Implementation**

- Parallelize using graphics processing units (GPUs)
  - Hundreds of cores



#### **Increasing Performance**

#### Track wet cells/blocks Multiple GPUs





#### **GPU Benchmarks**

GPU: Tesla C2050
 – 448 cores @ 1.15 GHz

CPU: Intel Xeon x5670
 12 cores @ 2.93 GHz







#### **Implementation Uses**

- More interesting problems
  - Larger domains
  - Longer timescales
  - Parameter sweeps



- Increase model understanding
- Immediate intuition for results
- Emergency management





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### **Visualization Integration**

- OpenGL, GLFW
  - All data shared on GPU
- Render topography/water surface
- Simulate steps 
   → Swap data 
   → Render frame
- User interaction
  - Traverse the domain (WASD)
  - Interact with the simulation



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# **Virtual Reality**

Importance

- Intuitive
- Immersive
- The future!

- Powerwall
- CAVE
- Oculus Rift







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#### **Oculus Rift implementation**

- Extra steps
  - Get sensor information
  - Render two perspectives
- Distort scene
- 60 frames per second







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### **Visualization Benchmarking**





## **Future Work**

- Very short term
  - Add interaction to Rift
  - Controller usage
- Short Term
  - Increase performance of visualization
  - Multiple screens
- Long Term
  - Deploy to emergency planners





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#### **Image Sources**

- Ianl.gov
- wikipedia.org





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# Thank you!

#### Questions





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