



# Simulation of Coastal Inundation Using Virtual Reality Tools for Disaster Study: Opportunity and Challenges

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# Agenda

- Introduction and motivations
- What is Virtual Reality
- What is Augmented Reality
- Terrain mapping
- Water flow model
- advantages as well as potential drawbacks and challenges associated with VR

# Introduction

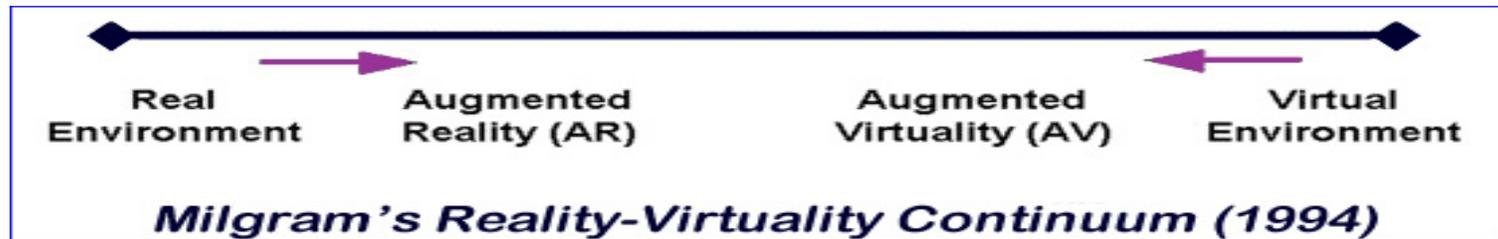
- Water plays a very important roles in human survival but its can also triumph every thing in it's path as flood, tsunami.
- Nowadays we are analyzing flood based on pre and post events, but recent development in technologies can help us to create a platform for visualizing and analyzing floods scenarios or to build a early warning system.
- Effective training is a cornerstone of disaster preparedness efforts worldwide.
- One such platform is virtual reality where User can create or load pre-defined scenarios into the scene and can control the environment parameters. Training in such environment will be an advantage.

# Virtual Reality

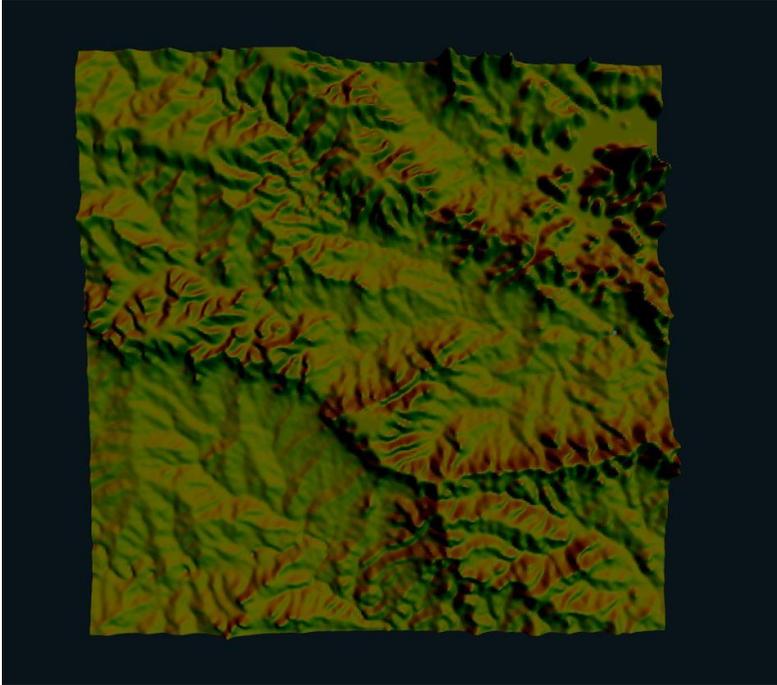
- Virtual reality is the term used to describe a three-dimensional, computer generated environment which can be explored and interacted with by a person.
- That person becomes part of this virtual world or is immersed within this environment and whilst there, is able to manipulate objects or perform a series of actions.
- Simply virtual reality replaces the real world with artificial

# Augmented Reality

- Augmented reality (AR) is a live direct or indirect view of a physical, real-world environment whose elements are *augmented* (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data.
- It is related to a more general concept called mediated reality, in which a view of reality is modified by a computer.
- Simply Interaction of a computer generated scene with real world objects



# Cont..



VR



AR

# Disaster Response training

- disaster response training and exercises, preparedness efforts continue to primarily rely on three conventional training methods:
  - classroom-based instructive teaching;
  - web-based training that consists primarily of pre-recorded, user-paced presentation material; and
  - real-life drills and tabletop exercises of varying scales.
- The advent of technologically-based approaches to disaster preparedness through virtual reality (VR) environments appears promising in its ability to bridge the gaps of other commonly-held established training formats.

# RATIONALE FOR VR-BASED TRAINING

- During a disaster or public health emergency, the ability for responders to react appropriately is driven not only by pre-existing knowledge and skills, but also to a considerable degree, their psychological state of mind and familiarity with similar scenarios.
- Particularly during high impact, low probability events, appropriate personnel response relies upon the ability to perform their designated roles.

# ADVANTAGES OF VR-BASED TRAINING

- Interactive VR-based disaster training can be tailored to specific users as well as organizations, based on their resources and hazard vulnerability analysis.
- a VR-based exercise can also allow an organization to test its emergency response plans in order to assess its effectiveness, and in turn, identify gaps and areas for improvement.
- VR-based applications can also facilitate consistent and repeated training over geographical and organizational divides.
- Another significant advantage of VR-based systems is the ability to incorporate additional realistic audio-visual stimuli, such as video clips depicting a mock event in progress or news reports that convey further information from the disaster.

# POTENTIAL DRAWBACKS

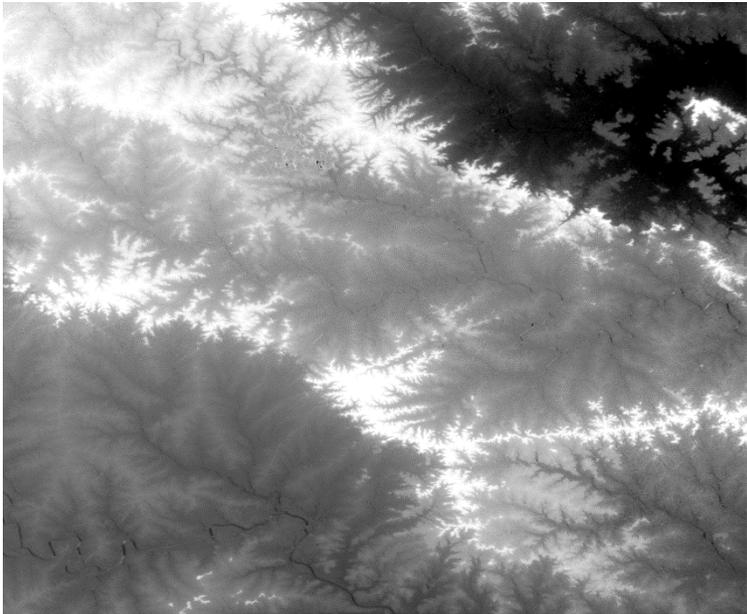
- The lack of familiarity with VR applications among disaster planning leadership may be a significant barrier to adopt such technology.
- The intuitive nature of VR-based training and its resemblance to commercial gaming platforms may lead some to perceive VR platforms as lacking credible and validated training benefit.
- The initial development costs associated with a VR-based training and exercise applications is high.
- Achieving the full immersion in the disaster scenario is difficult and its varies with person to person.

# Some examples

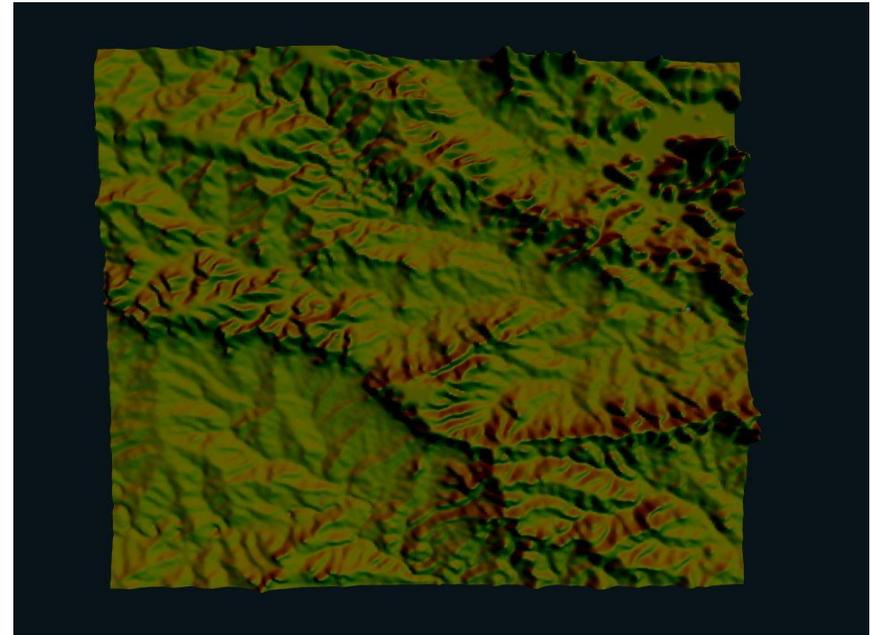
- ***New York City Office of Emergency Management (OEM)***: Advanced Disaster Management Simulator (ADMS). The system focuses on command element simulation and allows trainees to navigate through the virtual city by means of a joystick. Trainees can communicate emergency response needs through a facilitator who guides them through decision points and objectives.
- ***Los Angeles Police Department (LAPD)***
- ***NRSC virtual reality lab for visualizing and fly through***

# Terrain

- Terrain is generated with the help of DEM(digital elevation modal) which is a 3D representation of terrain



DEM

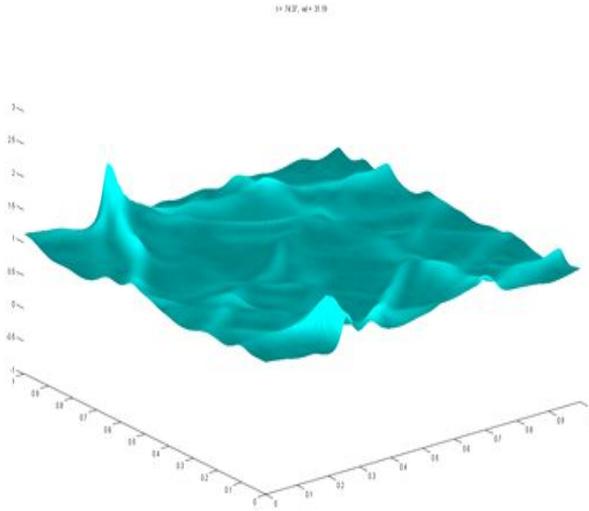


Terrain generated with help of DEM

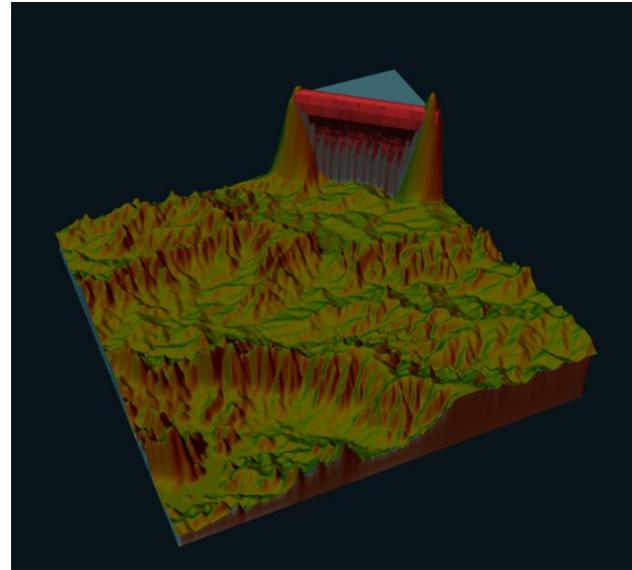
# Water model

- There are many methods to simulate water
  - Jerry model based on Bernoulli's equations, which is helpful in creating source and ripples.
  - Pipe model( Kellomäki model) based grid system, which is helpful in decreasing computational complexity and coupling with rigid body
- So we combined the above models where user can change the environmental conditions or interact with rigid body ,water and terrain

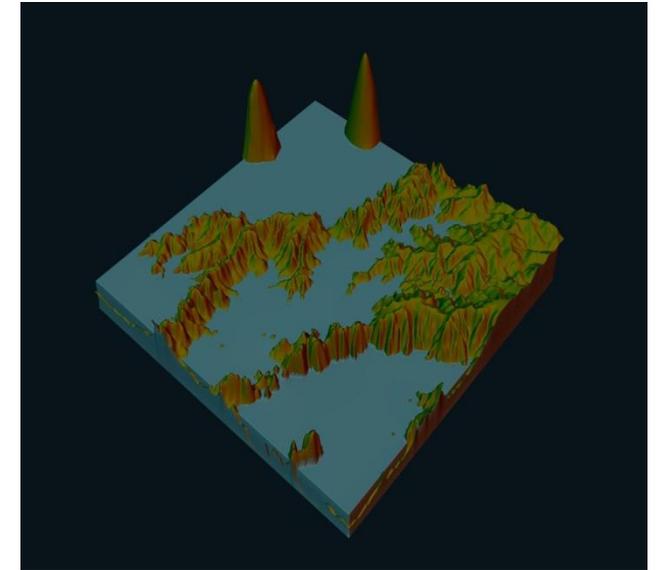
# Simulation Results



- Matlab simulation of water



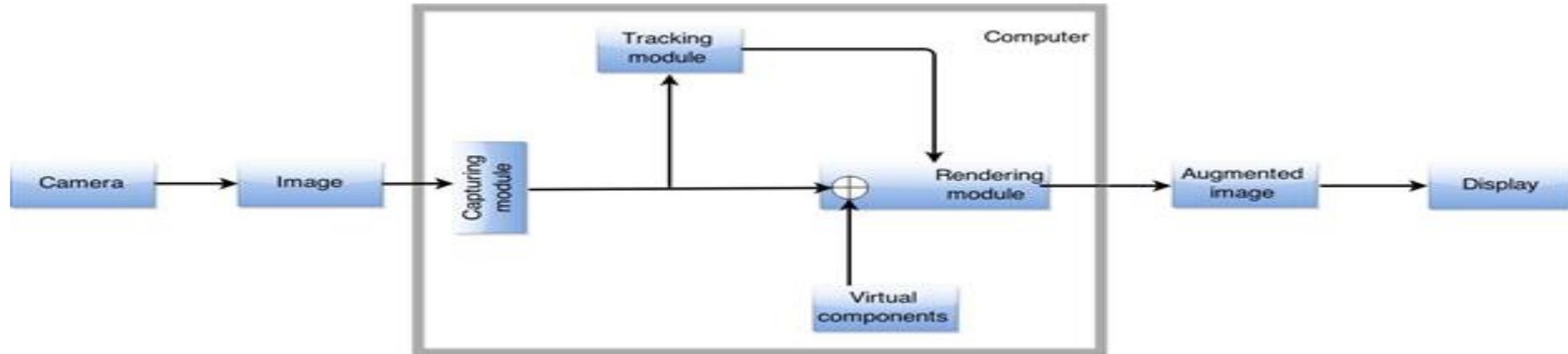
A virtual dam created on terrain



inundation of water over terrain

# Augmented reality overview

- Augmented reality develops a composite view to the user which is a combination of the real scene visualized by the user and a virtual scene generated by computer
- The tracking module calculates the correct location and orientation for virtual overlay



Flow chart of an AR system.

# Cont..

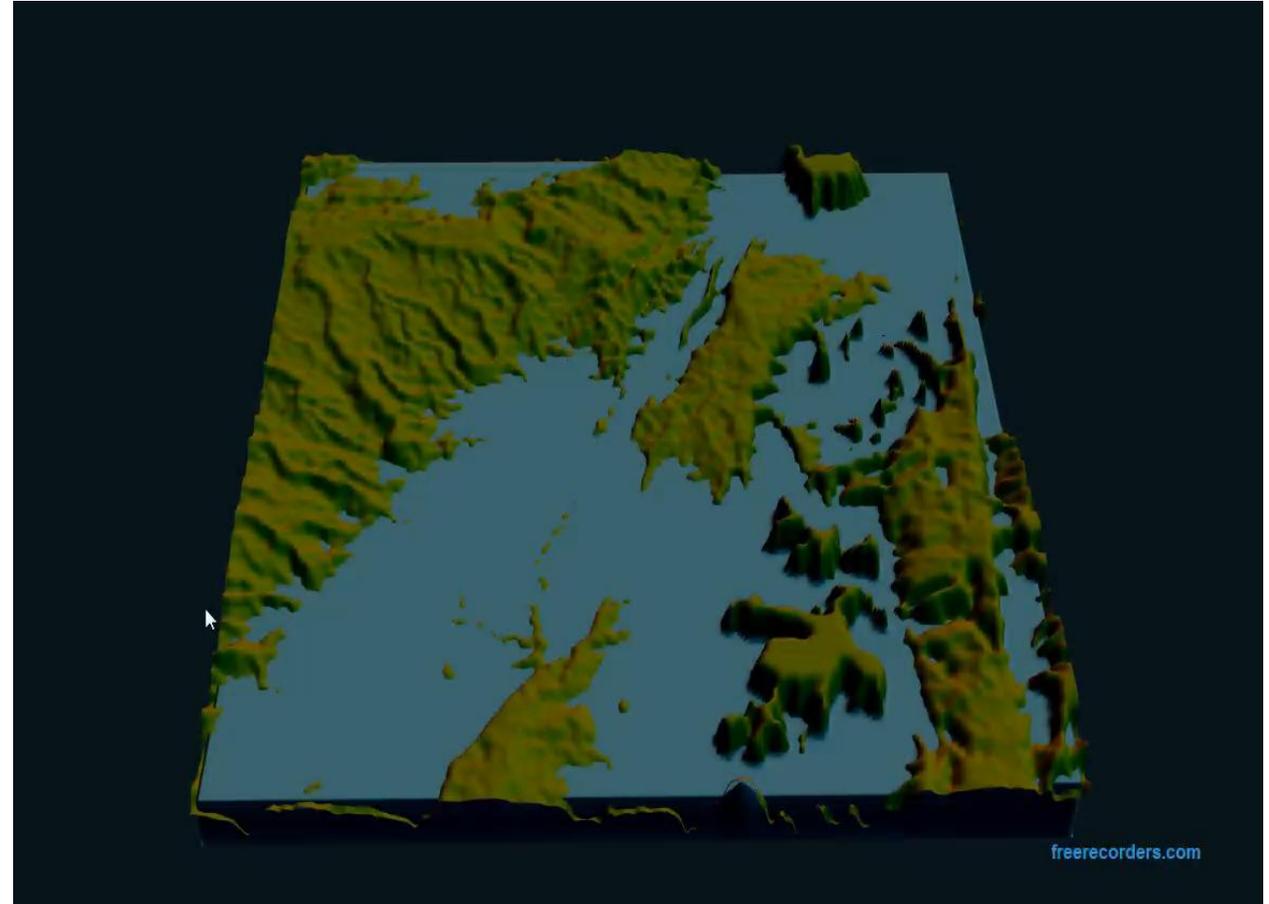
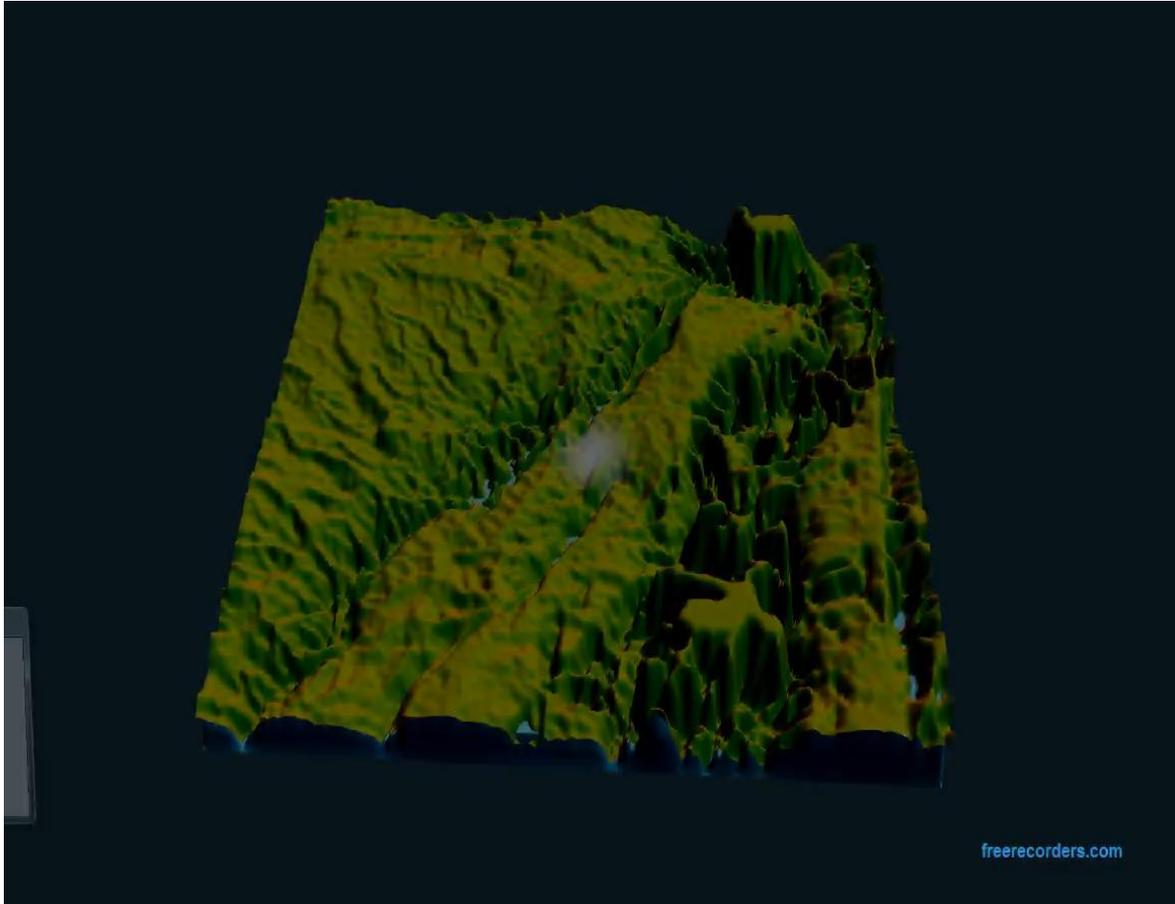


Augmented reality visualization mode of the platform



A cube augmented on the top marker

# Simulation Videos



# Conclusion

- The emergence of virtual reality platform-based technologies applied to disaster preparedness and response training offers significant potential advantages over other traditional forms of training, and is gaining increasing acceptance.
- In future virtual reality can play a major role in risk asset management.
- one can make a better plan for withstand the flood severity in the scene and go for decision making.
- VR is useful in planning of city and damage assessment
- Comparative research between VR-based and traditional modalities of disaster training is needed to explore the various aspects of realism, cost, and ultimately disaster readiness.

Thank you