



3D User Interface Design  
fundamental techniques, theory and practice

## Building Virtual Disney Worlds

Mark R. Mine  
Walt Disney Imagineering  
Research & Development Inc.  
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## Outline

- VR Studio Background/Overview
- Projects Overview
- Working with Designers, Case studies
- More Lessons Learned
- Future Directions

WALT DISNEY Imagineering



Research & Development, Inc.  
VR Studio

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## VR Studio - Then

- **Established in 1992 to explore the potential of VR technology for theme park attractions.**
  - Aladdin's Magic Carpet Ride

Mission Statement: Advance the frontier of visual quality and interactivity in computer graphics for the Walt Disney Company



## **VR Studio - Now**

- **Location Based Entertainment**
- **3D/4D Visualization for Theme Parks**
- **Interactive Experiences for the home**
- **High-quality pre-rendered graphics and animation for TV and theme park attractions**

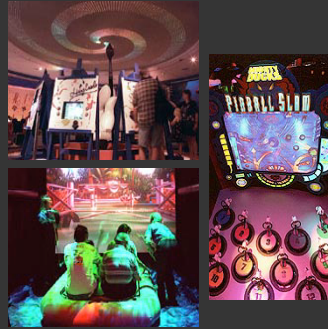
## DisneyQuest

- 5-story, 100,000-square foot “Interactive Extravaganza” operating in Orlando and Chicago
- Four “zones”
  - Score Zone
  - Explore Zone
  - Create Zone
  - Replay Zone



## DisneyQuest

- **6 Main attractions emphasizing high-end, real-time, interactive, computer graphics**
  - Cyberspace Mountain
  - Invasion! An Alien Encounter
  - Ride the Comix
  - Virtual Jungle Cruise
  - *Aladdin's Magic Carpet Ride*
  - *Hercules in the Underworld*













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# DisneyQuest Video

Aladdin's Magic Carpet Ride  
Hercules in the Underworld  
Pirates of the Caribbean

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## Working With Designers

- **Challenge: Overcoming the Designer's resistance to change**
- **Competition: Proud tradition of physical model building**
  - High level of detail works of art
  - Simultaneous, low-latency, perspective correct viewing by unlimited viewers

## The Case for VR

***Virtual simulations offer several key advantages over existing techniques:***

- Rapid modifications to existing models
- Interactive sight-line evaluation
- Macro and micro scales in same model
- Visualization of complex behavior
  - Wave effect for Paradise Pier
  - Tigger Bounce for Pooh's Hunny Hunt

## The Disney Advantage

### *Why VR works at Disney:*

- **Large-scale, high-cost construction projects benefit greatly from VR**
  - Unique designs
  - Customized materials
  - Specialized construction techniques
- **In-house artistic talent helps maximize effectiveness of our VR visualizations**

## Case Study: Paradise Pier

- One of three major sections of Disney's California Adventure (opening 2001)
- Initially hired to visualize coaster launch wave effect
- The power of 3D visualization obvious early on
  - Design flaws identified and corrected early in the design cycle



## Paradise Pier Visualization

- **Interactive 3D model enables multiple forms of visualization:**
  - Designer walkthroughs
  - Ride simulations
  - Sightline analysis
  - 4D simulations (3D model + time) for construction planning/visualization
    - <http://www.stanford.edu/group/4D/4D-home.htm>

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# Paradise Pier & R&D CAVE



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## Paradise Pier Flythrough and 4D Simulation

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## 4D Construction Simulation

- Facilitates exploration of resource/ workforce allocation (work shielding)
- Helps avoid costly design errors and last minute changes in the field
- Goal is a womb-to-tomb system organized around 3D model
  - Central repository for all construction, operations, and facility information

## Paradise Pier

- **Amortize cost of building 3D model by reusing models in multiple simulations**
  - Lagoon show design/development
  - Crowd flow simulation/analysis
  - Rescue/safety simulation/analysis

## Lessons Learned

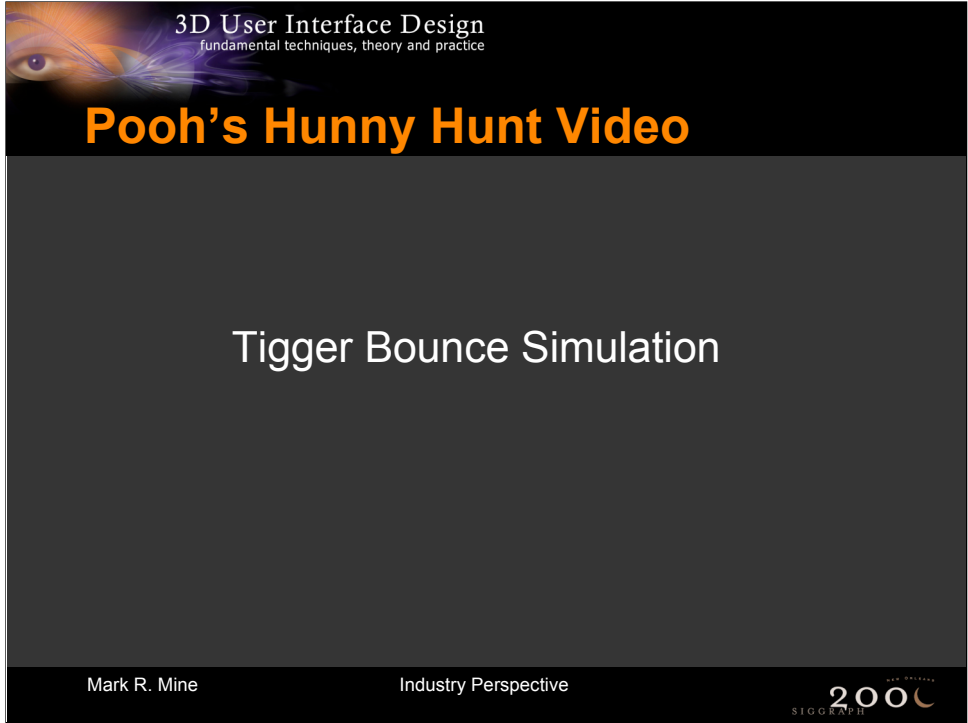
*The importance of CAVEs as a display medium*

- **Large number of simultaneous viewers encourages interactive design sessions**
  - Demos into Design Sessions
- **Powerful communication tool**
  - Paradise Pier pre-bid
- **Externalizes discussions**

## Case Study: Pooh's Hunny Hunt

- Major attraction developed for Tokyo Disneyland (opening 2000)
- Originally hired to visualize Tigger bounce effect. Can we make the guests feel like they're bouncing with Tigger?
  - 1 bouncing car
  - 2 layers bouncing scenery
  - 4 layers bouncing video





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# Pooh's Hunny Hunt Video

Tigger Bounce Simulation

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## Pooh's Hunny Hunt

- **Simulation effort quickly expanded to include verification of ride timings**
  - Free-ranging computer controlled vehicles
  - Too complex for miniature cameras/models or pre-rendered visualizations
- **VR simulation enabled designers to quickly evaluate ride profiles from the guest's perspective**
  - 2D ride planning tool misleading

# Overhead View



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## Guest's Perspective



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## Pooh's Hunny Hunt Video

Free-Ranging Vehicle Simulation

## Pooh's Hunny Hunt

*3D Model also utilized in multiple ways:*

- **Sightline verification used to validate reduction in number of audio-animatronic figures**
- **Real-time model used in planning of media development**
  - Audio timing
  - Tigger bounce visuals

## Lessons Learned

### *CAVEs as a display medium (again)*

- The importance of first person perspective for ride timing verification
- Multiple users
- Powerful communication tool
  - Selling Hunny Hunt to Oriental Land Company

## More Lessons Learned

### *The importance of in-the-world tools*

- Object placement/control tools
- Curve editing for camera/object paths
- Animation controls

### *Need to better span the space of display devices!*

- Tools which work from desktop to CAVE

## More Lessons Learned

*The importance of physical interfaces...  
Especially for facile camera control*

- Aladdin's flying carpet interface
- Pirates steering wheel
- Controls for simulation and pre-viz

## More Lessons Learned

### *The importance of late-binding languages*

- **Interactive scripting layer (based upon Scheme/Squeak) on top of high-performance C++ layer**
  - *Rapid implementation/iteration of dynamic environments*
  - *On-the-fly GUI building critical for flexible simulation control.*

### *Impossible to know what designer wants*

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## Future Directions

### *DIRECT: Disney's Interactive Real-time Environment Construction Tools*



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## DIRECT

- **Hardware**
  - Rear-projection desktop with pen-based input
  - Large FOV stereo projection screen for immersive viewing
  - 6 DoF tracking for head-tracked stereo and direct manipulation
  - Flexible device layer for incorporating joysticks, buttons, and other physical controls

## DIRECT

- **Features**
  - Intuitive direct manipulation interface for placing and sizing of 3D objects
  - Late-binding scripting layer for flexible control of dynamic simulations
  - Powerful tools for 3D curve editing and camera control

## Future Directions



- Fourth generation **open-source** VR software system
- Real-time 3D rendering
- Incorporates powerful tools for rapid prototyping  
based on DIRECT and Squeak
- Will run on any platform (PC, Dreamcast, PlayStation2, etc.)
- Visit <http://www.panda.org> for more details