

Video Game Play and Design:
Procedural Directions



SIGGRAPH
2001

Dominic Mallinson

Director of Technology, Research and
Development, Sony Computer
Entertainment of America



SIGGRAPH
2001

Tom Hershey

Vice President of Operations, Sony
Pictures Imageworks



SIGGRAPH
2001

Bill Swartout

Director of Technology, Institute For
Creative Technologies



SIGGRAPH
2001

Janet Murray

Director of Graduate Studies
Information Design and Technology
Program,
Georgia Institute of Technology



SIGGRAPH
2001

Video Game Play and Design:
Procedural Directions



SIGGRAPH
2001

Procedural Techniques for Interactive CG

Dominic Mallinson



SIGGRAPH
2001

Dominic Mallinson

What do I mean by a “procedural technique?”

- Any description that is not explicit
 - triangle meshes are explicit
 - motion capture animation is explicit
- Procedural techniques
 - modify a description via an algorithm
 - change with the state of the simulation
 - are calculated on the fly

SIGGRAPH
2001

Dominic Mallinson

PROS of Procedural Techniques

- Interactivity
- Scalability
- Variety
- Cost
- Storage and bandwidth

SIGGRAPH
2001

Dominic Mallinson

CONS of Procedural Techniques

- Not suited to everything
- Not as good as Art and Capture
 - (in a fixed situation)
- Can use lots of processor power
- Can be complex and unpredictable

SIGGRAPH
2001

Dominic Mallinson

Modeling with Procedural Techniques

- Generally Good For
 - Plants
 - Terrain
 - Biological forms
- Generally Bad For
 - man made objects
 - precise representation

SIGGRAPH
2001

Dominic Mallinson

Animation with Procedural Techniques

- The goal is interaction
- Simulating the Physical World
 - dynamics, cloth, fluids, smoke, fire, fracture
- Modified Animation
 - I.K. , motion blending etc.
- Behavior and Autonomous Characters
- Controllers

SIGGRAPH
2001



Modified Animation

- Using key frame artist generated or motion capture data as basis
 - interactivity requires procedural modification of the animation
 - motion blending
 - inverse kinematics
 - physical modeling



Physical Simulation

- Makes interaction look real
- Computationally very intensive
- Difficult to make robust
- Can be inconsistent in performance
- Lots of research still to be done!



Autonomous Characters

- The goal is life like character behavior
- Simple scripting and FSM
- Cognitive modeling
- Steering behaviors and path finding
- Learning algorithms
 - neural nets, genetic algorithms
 - off line vs. real time learning



Controllers

- Where behavior meets physics
 - How an 'action' becomes a 'motion'
 - "Walk Forward" through an arbitrary environment
 - Avoid obstacles, balance
 - Look natural



Examples

- Lifeforms :- Latham and Todd
 - an example of procedural modeling
- Bird-Fish-Mouse
 - autonomous characters
 - modified animation
 - procedural water



Video Game Play and Design: Procedural Direction



Procedural Simulation: Time To Get Real
Tom Hershey




Tom Hershey

Procedural Simulation

- Realistic Behaviors - "A.I."
- Any "On-The-Fly" Generated Action/Asset
 - NPC's, Terrain, Textures, Weather, etc.
- Advantages:
 - Sophistication, Volume, Speed, Reusability
- Drawbacks:
 - Emerging Science, Complex, Expensive



Tom Hershey

Overview

- Evolution of Game Consoles
 - More cycles, more storage, dynamic content
 - Procedural simulation as emerging R&D
- Impact on 3 Fronts:
 - Users
 - Developers
 - Unlikely Partners



Tom Hershey

The Old Days: Cram It In...

- Graphics, Mechanics, Design
 - Balancing cycles, storage
- Procedural Simulation
 - Pushes boundaries of game technology
 - Often forced to utilize "leftover" resources



Tom Hershey

Fitting It All In The Box

Game Mechanics	Design
Graphics	Procedural Simulation



Tom Hershey

A Bigger Box To Fill...

<ul style="list-style-type: none"> • Advanced UI, • Physics Engines, • Smart Cameras, etc. 	<ul style="list-style-type: none"> • Massive Worlds, • Hybrid Genres, • Sophisticated Sound, Stories, etc.
<ul style="list-style-type: none"> • Higher-Res Models, • Natural Movement, • Photorealism, etc. 	<ul style="list-style-type: none"> • Smarter NPC's, • Responsive Environments, • ???



Today: Still Cramming, But...

- Faster Hardware
- High Capacity Delivery
 - CD v. DVD
- Local Storage
- Additional Content Via Internet

All Lines Point To Procedural Simulation

The X Axis: The User

- Deeper, Richer Content
 - Experience to showcase hardware capability
- Enhanced Gameplay
 - Smarter NPC's,
 - Wider variety of interactions
 - Variations from session to session
- Immersive Style Over Hyperrealism

The Y Axis: The Developer

- “That’s A Damned Big Box...”
 - Producing enough content
 - Internet connectivity = even more content
 - More money + more time = greater risk
 - Mechanics, Design, Graphics & A.I. all demand higher levels of expertise
 - How can I supplement my talent pool & spread my risk?

The Z Axis: Unlikely Partners

- The Motion Picture/TV Effects Industry
 - Historically overlapping talent pool
 - Gap in CG and Procedural Simulation narrowing
- Academia
- Console Manufacturers
- Other Centers of CG Research
 - Architecture, Medicine, Engineering, Military

Procedural Simulation Satisfying:

- The User
 - Provides deep and challenging content
- The Developer
 - Provides economic way to produce larger volume of rich, innovative content
- The Now-More-Likely Partners
 - Additional revenue source
 - Real World application of their code

Tom Hershey

Making Procedural Simulation Work

- Development of Modular Code
 - Approach like a Graphics Engine
 - Amortize over multiple titles
- Enlist 3rd Party Resources - Joint Ventures
- Strive For Balanced Gameplay
- Establish Defining Style Instead of Realism

Video Game Play and Design: Procedural Directions

AI for Virtual Humans

Bill Swartout



Bill Swartout

A bit of background...

- Major goal at ICT:
Create compelling VR environments for training
 - High quality graphics
 - Immersive sound
 - Strong storyline
 - Virtual humans

Bill Swartout

AI Virtual Humans

- Behaviors not pre-scripted
 - Behave by understanding situation and reasoning about possibilities
- Communicate in natural language
- Can explain actions & coach
- Respond emotionally to situation

Bill Swartout

Looking back....

- Early attempts failed to create unified intelligent systems exhibiting a broad variety of behaviors

Bill Swartout

What's different now?

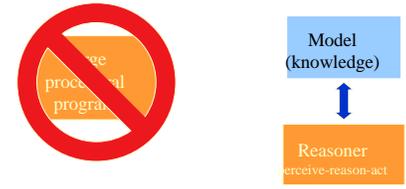
- Faster, more powerful (& cheaper) hardware
- Some of the hard problems have working solutions
 - e.g. speech recognition
- Better software environments support modular architectures
 - Don't have to build it all yourself
- Hybrid approach: synergy through mixing techniques
 - Symbolic, probabilistic, neural nets, etc.



Bill Swartout

What's different now? (cont'd)

- Model based programming




Bill Swartout

Example: Model Based Programming for Task Oriented Domain

Model	Task2	Task3	Task4
Task1	Preconditions:	Preconditions:	Preconditions:
Preconditions:	Effects:	Effects:	Effects:
Effects:			

↓

Reasoner

↓

Task3 → Task4 → Task1

- Robust to changes in world state
- Model easier to modify
- Model explainable
- Model can be used to understand other's actions



Mission Rehearsal Project: Operations in the New Millennium




Bill Swartout

Mission Rehearsal Exercise Project

- Virtual Reality Environment
 - Immersive Audio and Graphics
 - Virtual Humans with reasoning and emotion
 - Locals
 - Friendly and hostile elements
 - Coach
 - Dilemmas and decisions



Bill Swartout

ICT Virtual Reality Theater



Mission Rehearsal Clip

Coaching

Missing Emotions



Adding Emotions



Bill Swartzout

Summary

- Using AI we're beginning to create characters that have much richer behaviors and depth
- Opens up possibility for new kinds of games

Video Game Play and Design: Procedural Directions



Procedural Character Design

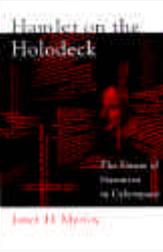
Janet Murray





Janet Murray

Computer as Storytelling Medium



- Can there be significant new forms of storytelling in the new digital medium?
- Yes, because it has its own expressive properties



Janet Murray

What would it take to get there?




Janet Murray

Characters Past




Tell me more about your mother.



Janet Murray

Eliza's animation did NOT involve

- Still images
- Moving images
- Sound
- "Multi" media



Joseph Weizenbaum, Eliza 1966



Why Eliza Works

Tell me more about your mother

Joseph Weizenbaum, Eliza 1966

- Pattern matching
- Shtick=formula
- Scripting the interactor
- Scenario!!



Why Woggles Worked



Joseph Bates, Woggles 1992

- Readable cartoon gestures of greeting, inviting, fear, menace...
- Shrimp's programming glitch provided needed dramatic focus
- Believability not realism



Virtual Pets

Silas, Bruce Blumberg, MIT 1994



Petz

Dogz, PFMagic 1990s



Autonomous Agent Architectures

Silas

- Based on science of animal behavior
- Elaborated model of inner states
- Everyday props, e.g. ball
- More complex, less dramatic



Dogz & Catz

- Based on shtick of cartoon critters
- Expressible model of inner states
- Dramatic props, e.g. mouse, catnip
- Less complex, more fun



Lessons from the Past



- Scenario shapes expectation
- Props shape participation
- Don't program what you cannot display
- Believability not realism
- Character elicited by interaction



Characters Present



SIGGRAPH
2001

Characters in Immersive Worlds

- Genre fiction world provides scenarios, props, potential dramatic actions
- Detailing reinforces believability
- Range of characters limited



SIGGRAPH
2001

Weapon/Target Characters



Quake, id software

SIGGRAPH
2001

Targets or Characters?

- Do they have their own trajectories?
- Do they move and act when we can't see them?
- Are they most interesting when on fire?



Deus Ex

SIGGRAPH
2001

Buddy Character



Paul Deus Ex

Hero and brother/sidekick are extensions of their weaponry

SIGGRAPH
2001

MMORGs: Massively Multiplayer Online Roleplaying Game Characters

- Expressive gestures derived from genre scenarios
- Need for dramatic compression
- More backstory than can be expressed in gameplay

Asheron's Call, 1999

SIGGRAPH
2001

Will Wright's The Sims (2000)

Yuppy scenario: shop, work, party, marry, parent
Persistent, detailed, participatory world



Why the Sims Works

- Readable social actions
- Bildungsroman plot, courtship and work ethic scenarios
- Expressible states
- BUT: problem of focus remains



Improving Character Simulations



Dramatic Compression

- Time
- Event structure
- Episodic structure

Dramatic Actions

- Fewer Chores!
- Dramatic Props



Characters Future



Parameterized Characters

Questing hero:

- Heritage Group
- Appearance
- Clothing
- Profession
- Attributes
- Skills



Parameterized Characters

Roommate:

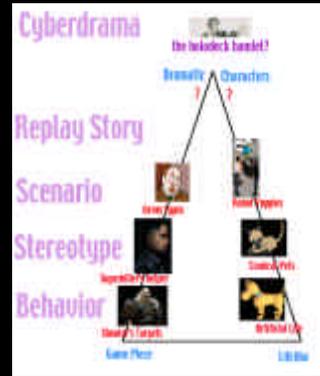
- Neat
- Outgoing
- Active
- Playful
- Nice



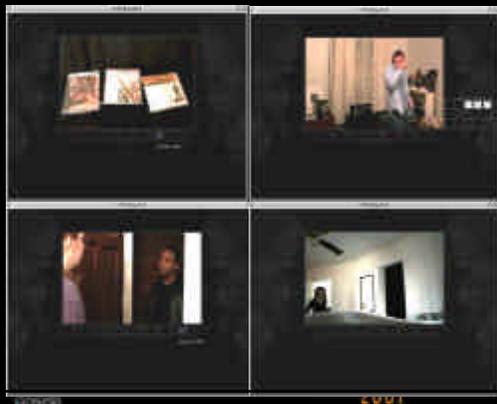
Parameterized Characters



- Danish Prince??
- melancholy?
 - tolerance for flattery?
 - irony?
 - self-doubt?
 - homicidal/suicidal?
 - madness meter?!



Sarah Cooper: Reliving Last Night



Variant character / Variant POV



Michael Mosley
Buford Highway
Georgia Tech



Janet Murray

Creative Applications Lab

Sarah Cooper
Reliving Last Night

Michael Mosely
Buford Highway



Janet Murray

Creative Applications Lab

Sarah Cooper
Reliving Last Night

Michael Mosely
Buford Highway



Janet Murray

Creative Applications Lab

Sarah Cooper
Reliving Last Night

Michael Mosely
Buford Highway



Video Game Play and Design: Procedural Directions

