

# Games Research: the Science of Interactive Entertainment

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Research and Development

Sony Computer Entertainment America

Course 39

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# Goals of this course

- Present specific game–related research
- Strengthen ties between the SIGGRAPH and game development communities:
  - Encourage contributions to SIGGRAPH by the game development community
  - Encourage academic researches to pursue topics related to game development.
  - Encourage game developers to follow developments in the research world.

# In this introductory session...

- Background on game research
- Today's speakers
- Two communities
- A very brief history of video games
- A quick peek at my own recent work
  
- Note course web page:
  - <http://www.red3d.com/siggraph/2000/course39/>

# Audience survey

How would you describe yourself?

- 1: Academic researcher
- 2: Game developer
- 3: Game researcher
- 4: Film/TV production (including effects)
- 5: Tool developer (hardware/software)
- 6: Artist
- 7: Other

# Games Research

# Games Research

- Research underlies game progress
- Game industry draws on research from
  - academia
    - SIGGRAPH, partnerships with universities, ...
  - corporate R&D labs
    - in the game industry and elsewhere
  - in-house work by game developers
    - very limited resources

# Research versus production

- Speakers at two SIGGRAPH 99 panels:

R&D for Film Production

How SIGGRAPH Research is Used in Games

agreed:

- there is no time during production for research
- at best, they could adapt published research to their needs
- depend on research community for innovative solutions to hard problems

# Speakers

# Speakers

- Craig Reynolds: introduction
- Jonathan Blow: terrain modeling
- Robert Huebner: progressive meshes
- Chris Hecker: rigid body dynamics
- Panel discussion: continuous LOD
- Robin Green: steering behaviors
- John Funge: intelligent characters
- All: questions & answers

# Craig Reynolds

- Research Scientist
- Sony Computer Entertainment America
- [craig\\_reynolds@playstation.sony.com](mailto:craig_reynolds@playstation.sony.com)
- <http://www.red3d.com/cwr/>

## Background:

- Interests: autonomous characters for animation and games, Evolutionary Computation, Artificial Life. Earlier work: animation system design, a game authoring system, and a technique for modeling surfaces immersed in flow.

# Jonathan Blow

- VP of Software Development
- Bolt Action Software
- [jon@bolt-action.com](mailto:jon@bolt-action.com)

## Background:

- Interests: modeling terrain with extremely high detail levels, and the fast rendering of materials with accurate reflectance properties. In 1995 he co-founded Bolt Action Software, which develops multiplayer games.

# Robert Huebner

- Director of Technology
- Nihilistic Software, Inc.
- innerloop@nihilistic.com

## Background:

- Contributed to *Jedi Knight*, *Descent*, *Starcraft*.
- Contributes to Game Developer magazine and serves on the advisory board for the Computer Game Developer's Conference.

# Chris Hecker

- Technical and Art Director
- definition six, inc.
- checker@d6.com
- <http://www.d6.com/users/checker/>

## Background:

- Interests: high-end physics and graphics technologies. Member of Game Developers Conference advisory board, contributor to Game Developer magazine, editorial board of The Journal of Graphics Tools.

# Robin Green

- Software Engineer
- Sony Computer Entertainment America
- [robin\\_green@playstation.sony.com](mailto:robin_green@playstation.sony.com)
- <http://www.robingreen.net/>

## Background:

- Interests: new graphical, dynamics and AI techniques for upcoming games. Created steering behaviors for *Dungeon Keeper 2*, real-time procedural textures for *Theme Park World* and an in-game Soccer AI for *FIFA Soccer Manager*.

# John Funge

- Research Scientist
- Sony Computer Entertainment America
- <http://www.jfunge.com/>

## Background:

- Interests: quasi-intelligent computer characters for use in computer games. His Ph.D. Work was a new approach to high-level control of autonomous characters. Author of the book "AI for Games and Animation: A Cognitive Modeling Approach"

# Two communities

# Two communities

- While they share much in common, the two worlds of **computer graphics and animation** and **games** have separate cultures, conferences, and publications.

# Two communities: moving together?

- Historically, the game industry had an *ad hoc* and non-academic software culture.
- Increasingly, game developers look to SIGGRAPH and other research forums.
- More academics now attend and speak at game conferences.
- More game developers attend and (as in this course) speak at SIGGRAPH.

# Two communities: conferences

- Graphics (academic, film, TV, VR...and games)
  - SIGGRAPH
  - Graphics Interface
  - Eurographics
- Games
  - Game Developers Conference
  - *...and increasingly, all of the above*

# Two communities: periodicals

- **Graphics** (academic, film, TV, VR...and games)
  - ACM TOG (Transactions on Graphics)
  - IEEE Computer Graphics & Applications
  - Journal of Graphics Tools
  - Computer Graphics World
- **Games**
  - Game Developer Magazine (online: Gamasutra)
  - *...and increasingly, all of the above*

# Two communities: books

- **Graphics** (academic, film, TV, VR...and games)
  - Computer Graphics: Principles and Practice (Foley, van Dam, *et al.*)
  - Graphics Gems series
  - Texturing and Modeling: Procedural Approach (Ebert, Musgrave, Peachey, Worley, Perlin)
- **Games**
  - Game Programming Gems (Deloura)
  - Graphics Programming Black Book (Abrash)
  - Zen of Code Optimization (Abrash)
  - *...and increasingly, all of the above*

# A brief history of video games

# (pre) History of video games

- 1961: spacewar
  - Steve Russell at MIT on a PDP-1
- 1971: Computer Space
  - Nolan Bushnell at Nutting Associates. First dedicated game machine.
- 1972: Magnavox introduces Odyssey
  - Based on Ralph Baer's 1951 concept and a 1967 prototype.
- 1977: Atari introduces VCS (2600)

# Game history: on personal computers

- 1977: Apple 2
- 1982: Commodore 64
- 1985: Commodore Amiga
- 1987: VGA
- 1993: Doom
- 1995: Voodoo Graphics
- 1996: Quake
- 1997: Ultima Online

# Game history: consoles

- 1985: Nintendo Entertainment System
- 1989: Sega releases 16-bit Genesis
- 1991: Nintendo releases 16-bit SNES
- 1992: 3DO releases its 32-bit console
- 1995: Sega releases 32-bit Saturn
- 1995: Sony releases 32-bit PlayStation
- 1996: Nintendo releases N64
- 1999: Sega releases Dreamcast
- 2000: Sony releases PlayStation2

Some of my recent work

# Interaction with realtime flocks

- Based on the 1987 *boids* model of flocks, herds and schools
- Uses fast hardware (PS2), and spatial data structures to accelerate *boids*: about 6000 times faster than in 1987.
- Allows real time (60 fps) interaction with a group of about 300 birds.
- Includes behavioral state transitions

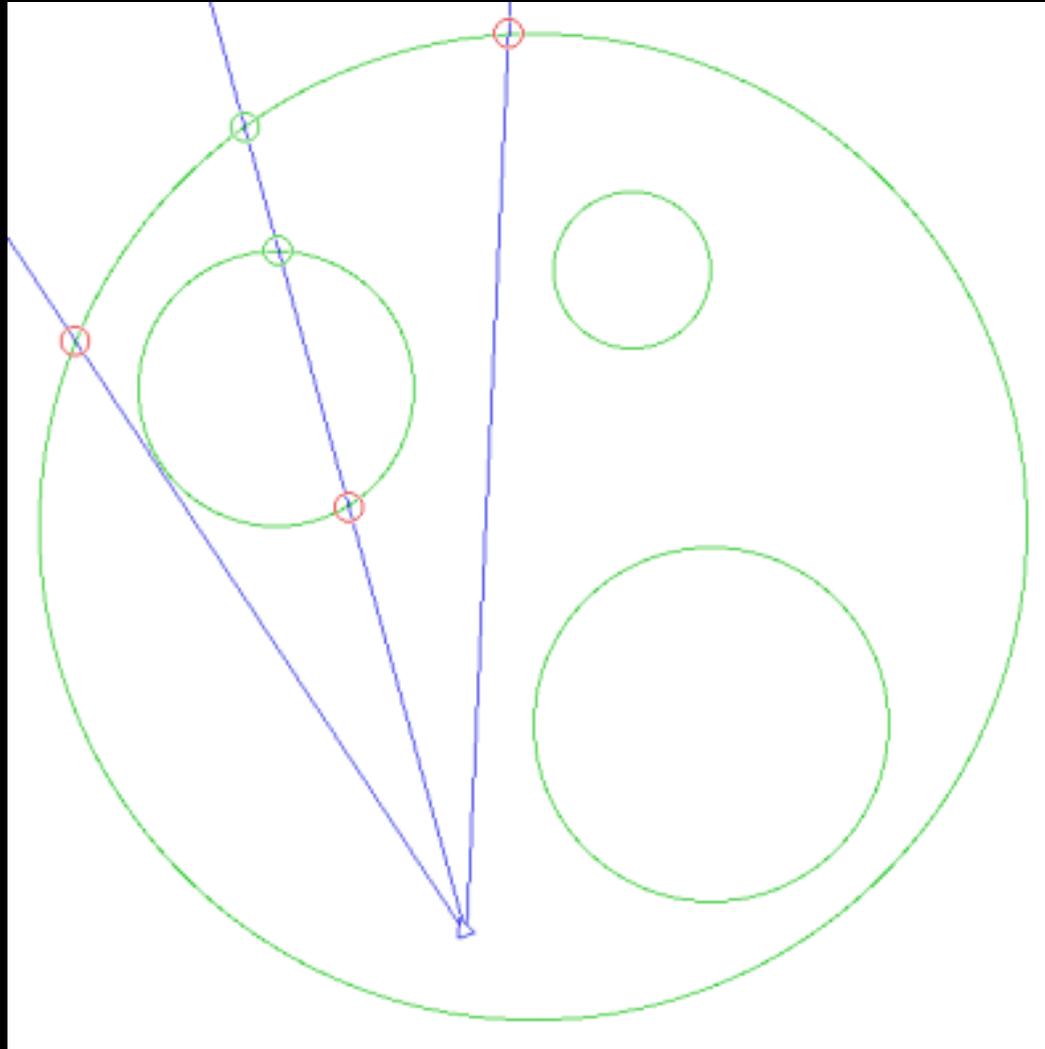
# Pigeons in the Park



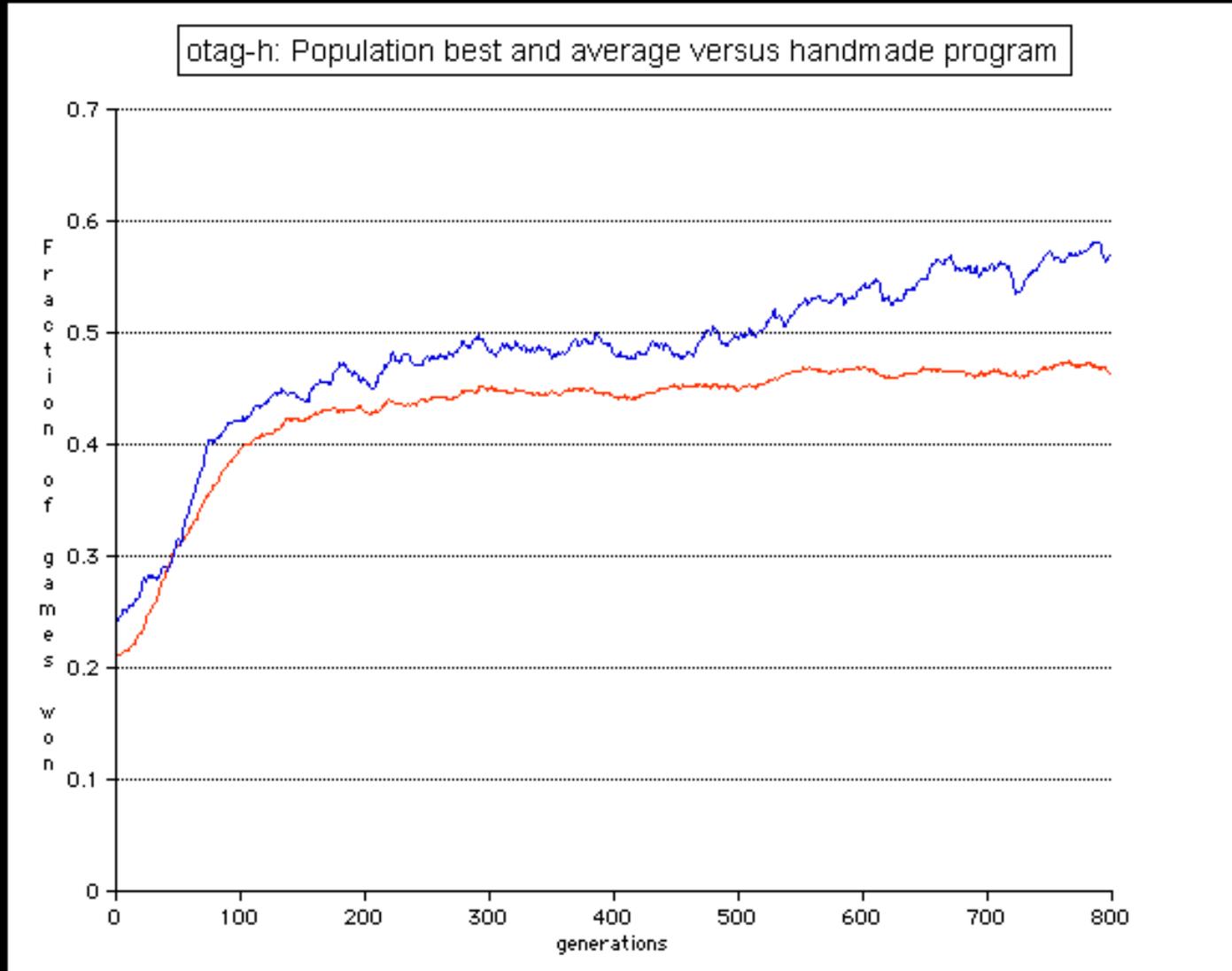
# Coevolution of Tag Players

- The game of tag
  - symmetrical pursuit and evasion
  - role reversal
- Goal: discover steering behavior for tag
- Method: emergence of behavior
  - coevolution
  - competitive fitness
- Self-organization:
  - no expert knowledge required

# Sensors and obstacles



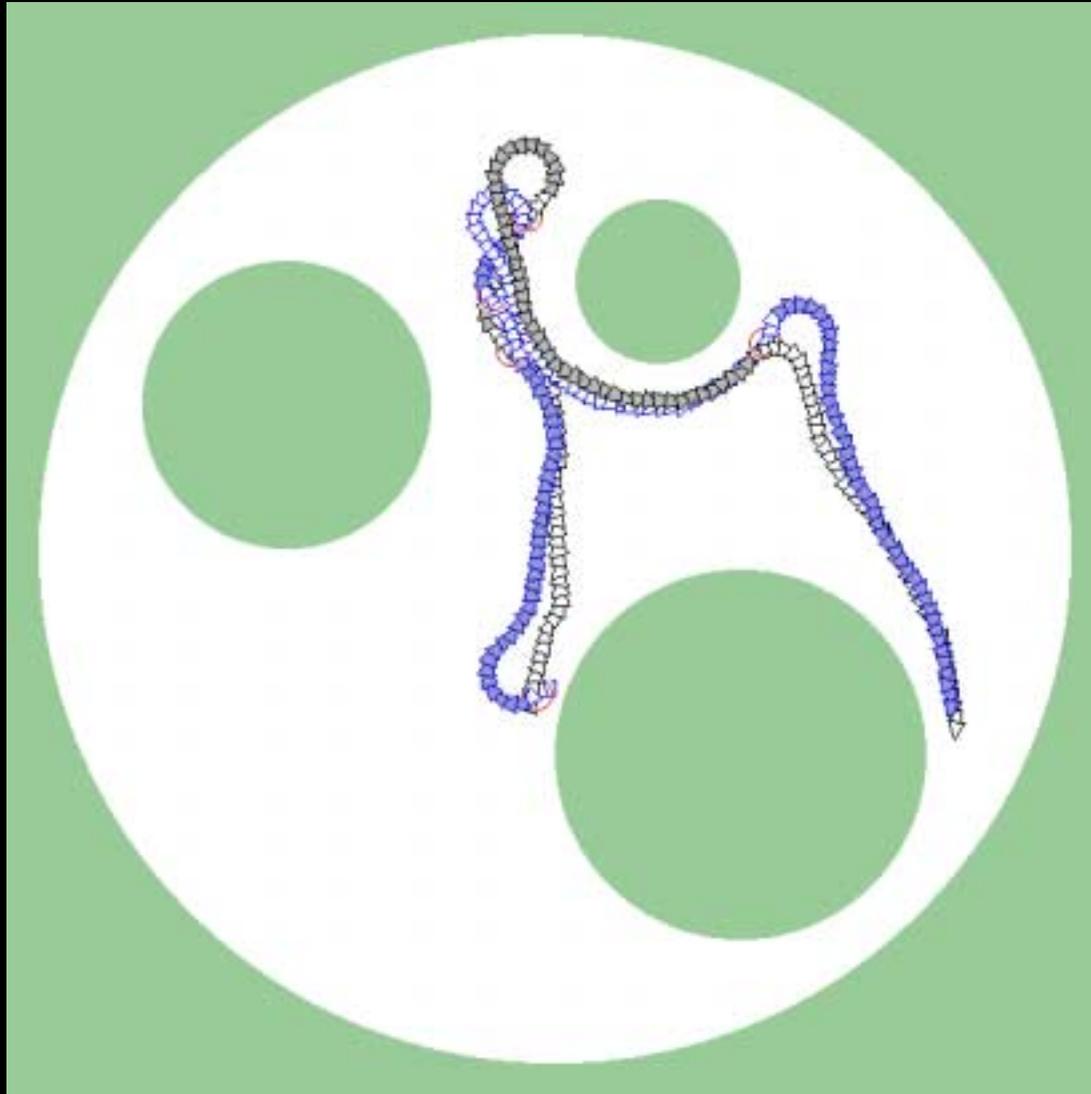
# It works!



# Typical fitness test (1)



# Typical fitness test (2)



# Competitive coevolution: summary

- Pros:
  - Can produce high quality players
  - Meets or beats human–designed players
  - Does not require knowing a winning strategy or how to implement it.
- Cons:
  - Requires very long computation time even for a very simple game.
  - Untested for games requiring complex strategy.



# Summary

- Game research
  - the field
  - this course
- Course speakers
- Two communities
- Video game history
- My work
  
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