

Games Research: the Science of Interactive Entertainment

Craig Reynolds

Research and Development

Sony Computer Entertainment America

Course 39

July 25, 2000

SIGGRAPH ^{NEW ORLEANS} 2000 

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
- <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

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
- <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

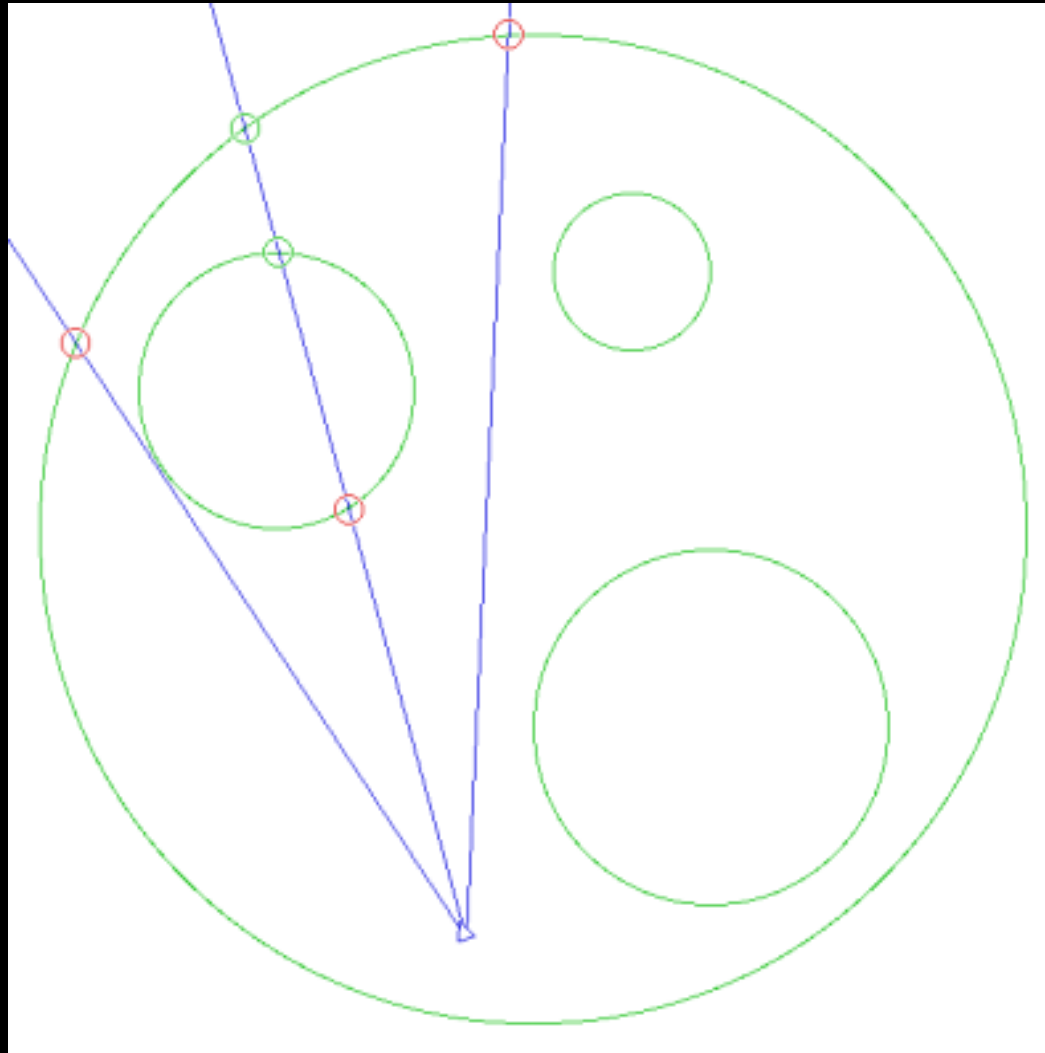
Pigeons in the Park



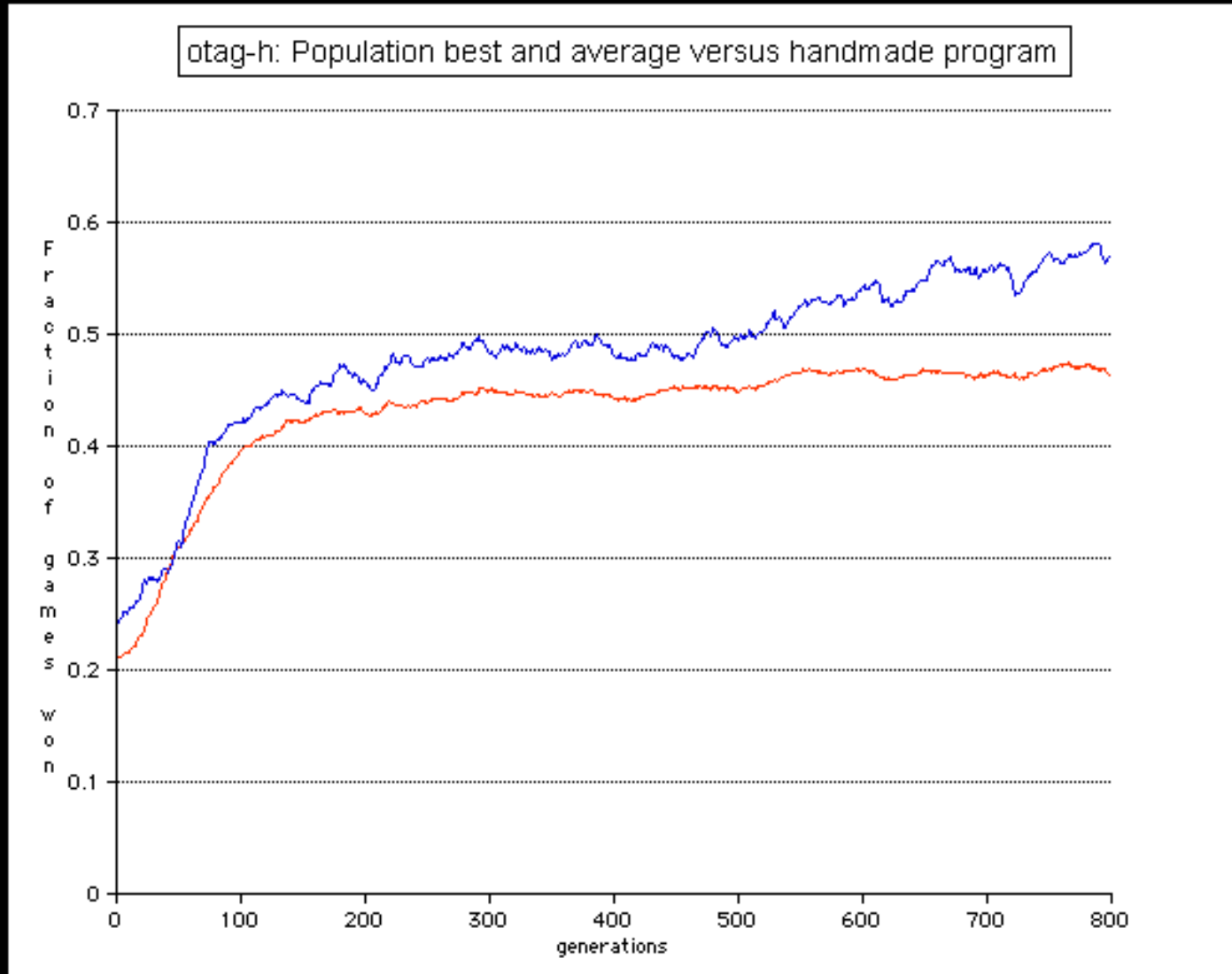
Coevolution of Tag Players

- 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



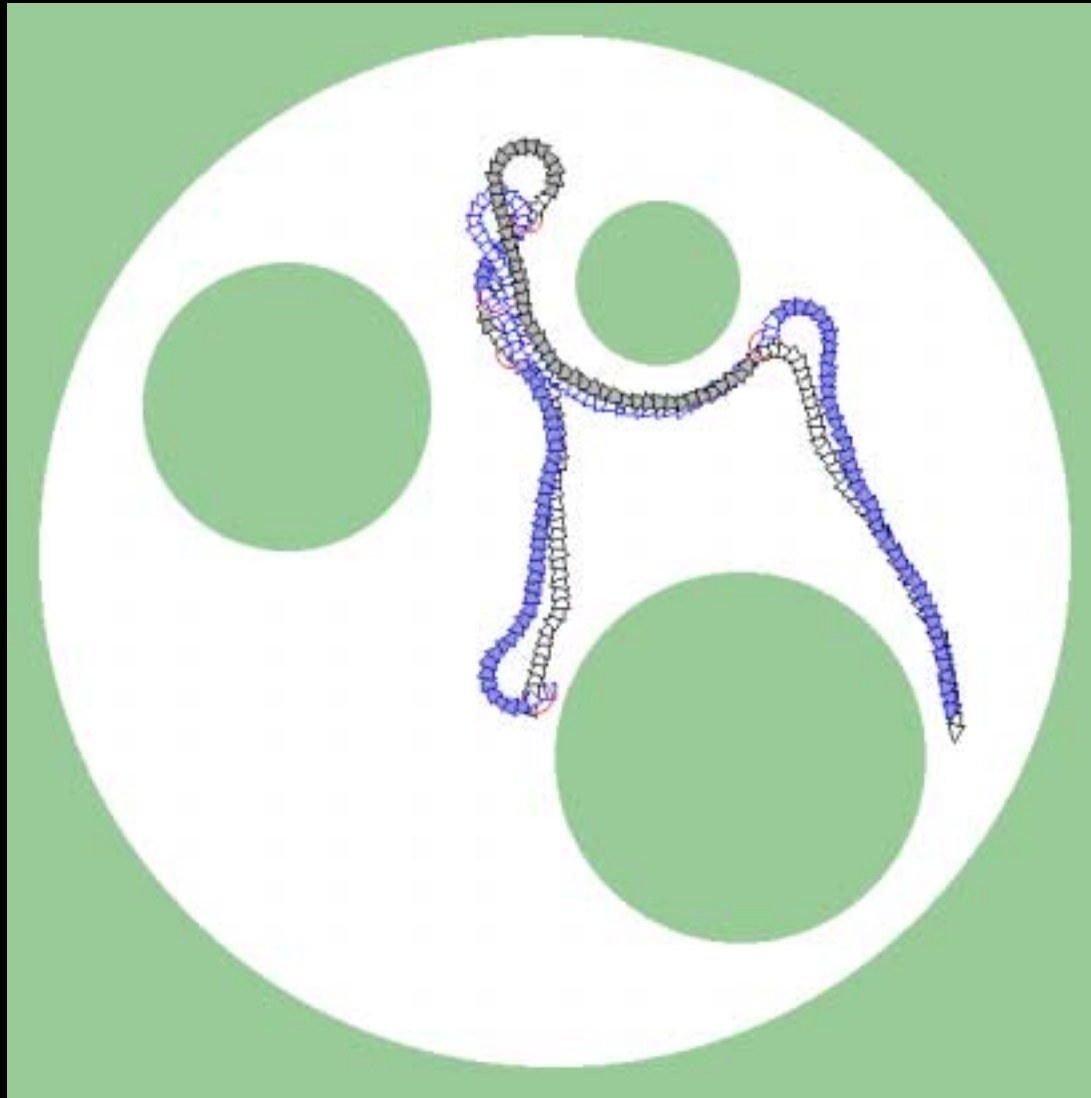
It works!



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

- Course web page
 - <http://www.red3d.com/siggraph/2000/course39/>



Computer Game Research 101- A Brief Introduction to the Literature. Date posted: December 1, 2002 Updated: Oct 23, 2006. By Jonas Heide Smith (smith@game-research.com) Published: December, 2002. A few years ago there wasn't much to talk about. Now, however, computer game research is booming resulting in common terminology, competing paradigms and serious discussion on the subjects of games and gaming. These perspectives on games were among the first to gain academic popularity outside the effects paradigm. The Road not Taken: The How's and Why's of Interactive Fiction. Game Research. http://www.game-research.com/art_road_not_taken.asp. * Turkle, Sherry (1984). In Proceedings of Australian Computer Science Week, Interactive Entertainment, 2018, ACM. Drachen, A.; Pastor, M.; Fontaine, D. J.; Liu, A.; Chang, C.; Chang, Y.; Sifa, R.; Runge, J. & Klabjan, D. (2018): To Be or Not to Be: Social: Incorporating Simple Social Features in Mobile Game Customer Lifetime Value Predictions. Society for the Advancement of the Science of Digital Games (SASDG) Publishing. Hitchens, M.; Richards, D. and Drachen, A. (2012): An investigation of player to player character identification via personal pronouns. In proceedings of the Digital Games Research Association Conference 2007 (Tokyo, Japan), 40-49. Tychsen, A. & Hitchens, M. (2006): Ghost Worlds: Storytelling and Consequence in MMORPGs. Digital Games Research Conference 2021-2022 The Digital Games Research Association (DiGRA) has as a central goal the support of an international conference on digital gaming. Eleven conferences have taken place, with two more already planned for 2019 and 2020. This document is a call for proposals for a committee and location to host the next series of DiGRA's international games research conferences. We are actively seeking proposals for 2021 and 2022. Digital Games Research Association. Entertainment Software Association. We simply leave it up as an archive This site attempts to bring together the art, science and business of computer games. We have a collection of game research articles, game book reviews and information pages on game topics. In particular the info pages need updating/revision and we're looking for editors who would like to take charge of one or more pages. Write a game book review. If you're in the game studies field and would like to review a game book for us (we'll get the book to you), write to smith@game-research.com. Read Tony Tulathimutte's article Trust, Cooperation, and Reputation in Video game research. Although video games were first developed for adults, they are no longer exclusively reserved for the grown ups in the home. Research in the video game market is typically done at two stages: some time close to the end of the product cycle, in order to get feedback from consumers, so that a marketing strategy can be developed; and at the very end of the product cycle to "fix bugs" in the game. After all, when it comes to introducing a new interactive product to the child market, and particularly such a young age group within it, we believe it is crucial to assess the range of physical and cognitive abilities associated with their specific developmental stage.