



CONTRACTOR DISCLOSURE FORM

712A

MORSS PK: (if known)

DEADLINE: 2 MAY 08
Fax to: 703-633-6086Principal Author: **Deborah V. Duong** Other Author(s):Principal Author's Organization and complete mailing address: **OSD/PA&E Simulation and Analysis Center** Principal Author's Signature: *[Signature]* Date: **May 5, 2008**1225 South Clark Street Suite 300
Arlington, VA 22202 Phone: 703-699-2341 FAX: 703-604-6400
Email: **debbie.duong.ctr@osd.mil**Title of Presentation: **"Strategic Data Farming: Verifying Wargame Adjudicators to support the Model-Game-Model Analysis Technique"** MORSS Agenda Manager ID#:This presentation is believed to be: SECRET CONFIDENTIAL UNCLASSIFIED and will be presented in:
 Special Session Tutorial Demo Poster CG: A-B-C-D-E-F (Click one) List all WG(a) #: **29, 32**
This work was performed in connection with a government contract. YES (Complete Parts I, II, & III)
This presentation is based on material developed by the author as part of company-approved research e.g. IR&D YES (Complete Parts I & II)
and was NOT done under a government contract. YES (Complete Part I only)
This presentation was NOT done under a government contract, contains no government information, is my own work and is approved for public release.This work was performed in connection with Contract #: **143681** let by (Activity): Dated: **7 May 08**Contractor Security Officers Title: **Facility Security Manager** Organization: **SAIC**
Printed name: **Kedrick, D. Howard** Complete mailing address: **1525 Wilson Blvd, Suite 800**
[Signature] Date: **7 May 08** **Arlington, VA 22209**Contractor Security Officer's Signature: *[Signature]* Email: **howardk@saic.com** Phone: **703-376-3153** FAX: **703-508-0506**The Releasing Official/Government Contracting Officer or Study Sponsor, with the understanding that MORSS Symposia are supervised by the OCNO N81, that all attendees have current security clearances of at least SECRET and that no foreign nationals will be present confirms that the overall classification of the presentation is:
 SECRET CONFIDENTIAL UNCLASSIFIED OTHER: _____ and authorizes disclosure at the meeting.Classified by: _____ Declassified by: _____ Downgrade to: _____ On: _____
 Distribution statement A: **Other distribution statement: (List here or attach separate sheet)**
This presentation/paper is unclassified, approved for public release, distribution unlimited, and is exempt from U.S. export licensing and other export approvals under the International Traffic in Arms Regulations (22 CFR 120 et seq.)Releasing Official/Gov't Contracting Officer or Study Sponsor's: Organization: **OSD/PA&E Simulation and Analysis Center**
Title: **Deputy Director** Complete mailing address:
Name: **LT Col Paul McAree** **1225 South Clark Street Suite 300**
[Signature] Date: _____ **Arlington, VA 22202**
Signature: *[Signature]* Email: **Paul.McAree@osd.mil** Phone: **703-604-6349** FAX: **703-604-6400**

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 01 JUN 2008		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE Strategic Data Farming				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) OSD/PA&E Simulation and Analysis Center Arlington, VA				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES See also ADM202527. Military Operations Research Society Symposium (76th) Held in New London, Connecticut on June 10-12, 2008, The original document contains color images.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



UNCLASSIFIED

Strategic Data Farming

Deborah Duong



UNCLASSIFIED



Human Judgment in Analysis

- How can we take advantage of human judgment in a way that is good for analysis?
 - Human beings have such better understanding of human contexts than computers do
 - In analysis like irregular warfare that involves the human terrain, this is more important
- The DoD does not trust computer simulation in this domain, and employs wargaming
 - But it is difficult to get enough repetitions for statistical significance of human judgments
 - They have compromised by using computer wargame adjudicators of social phenomena.
 - PSOM, SEAS, COMPOEX, etc.



Computer Adjudicators for Wargames

- Is it a good idea to use a computer adjudicator for a wargame for analysis?
 - You could get this worst of both worlds...
 - We are spending lots of money on the games and the software but,
 - You wont have enough repetitions to get statistically significant results anyway
 - The computer are usually better at playing a game, on its own terms, than humans are!
 - The world champion at chess is a computer program
- Model-Game-Model Technique
 - Uses iteration between human and computer to gain the best of both worlds
 - Humans are used to improve the model, not replace it



Model-Game-Model Technique

- Model Phase
 - Explore how the environment in the game may be manipulated so that an agent (human or ABS) may achieve its goal
 - Bring ways to “game the game” are to the surface
 - Modelers and Subject Matter Experts (SMEs) may change the game so that players win in more realistic ways
- Game Phase
 - Players play the improved game
 - Players suggest outcomes that are more realistic
 - Modelers may change the game so that players win in more realistic ways
- Model Phase
 - After several iterations, realism increases to the point that human beings are not needed to win in a realistic fashion, at which point automation (and statistical significance) is possible



Strategic Data Farming

- Strategic Data Farming may be employed in the first phase of the iterative model-game-model process
 - Strategic Data Farming is a way to explore how a player or an agent may succeed in a wargame or an agent based simulation (ABS)
 - Ways to game the game are exposed
- Strategic Data Farming makes use of Game tree technology from Artificial Intelligence
- Strategic Data Farming looks at worse-case-scenarios first
 - Desirable for analysis
 - Game trees win by the exploration of the worse case



Why do ABS and Wargames need Strategic Data Farming?

- ABS and wargames are typically nonlinear
 - New combinations of parameters contain surprises
 - Traditional parameter sensitivity testing for VV&A is inadequate
- Traditional Data Farming does a thorough exploration of the state space
 - Seeks to explore every combination of parameters
 - Takes supercomputers and vast computational resources
- In Strategic Data Farming, the emphasis is on the game theory of moves rather than parameters
 - There are usually fewer parameters in strategic games
 - What makes a game unique is strategy
 - Assumption of goals narrows down what exploration



Questions Answered

- Traditional Data Farming answers the basic questions of Agent-Based VV&A
 - Is every model outcome possible in the real world?
 - Is every possible real world outcome realizable in the model?
- Strategic Data Farming answers the basic questions of strategic games
 - Do strategies that win in the simulation win in the real world?
 - Do strategies that win in the real world win in the simulation?
- For Strategic Data Farming, once the model is refined so that the answer is yes, the game may be automated



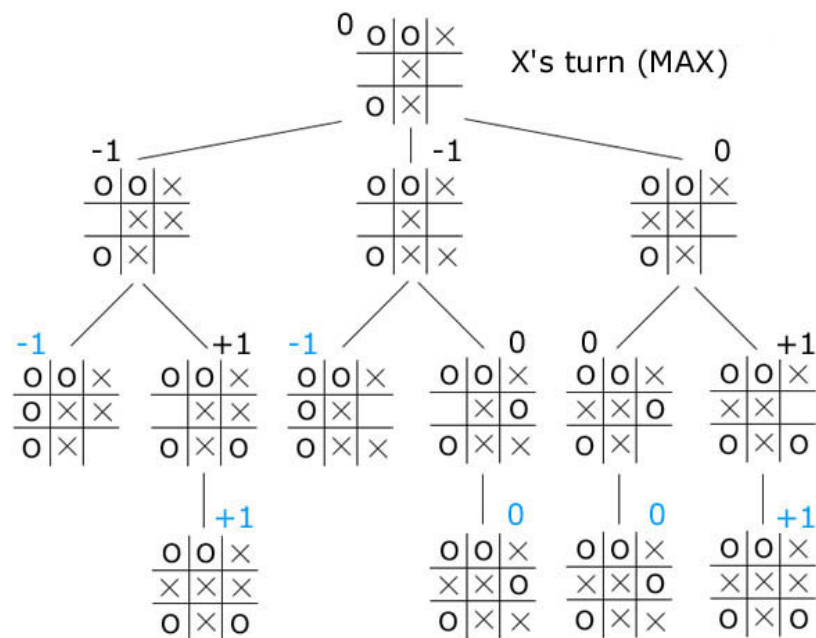
How Strategic Data Farming Works

- Replace a player or an agent of a wargame adjudicator or agent based simulation with an game tree agent
- The game tree agent needs 3 things
 - A board evaluation function: a way to tell how far the agent is from its goal for a particular state of the board
 - A list of all the legal moves that the player can make
 - If there are too many, they should be ranked according to their usefulness for a strategy
 - A list of all the changes that can be made in the agents environment
 - May include other moves of the players
 - If there are too many, they should be ranked according to how harmful they are to the agent's strategy
- Invert the game



How Game Inversion Works

- Play the game as though there are only 2 strategists
 - The replaced agent
 - The rest of the simulation
- A game tree is created in which the rest of the simulation is pitted against the agent's goals
 - The simulation itself is used to advance to the next move
 - The game is “branched”: For every move made, the top N moves of the opponents are tried
 - Alpha beta minimax quickens the search
 - A move is chosen when goal is reached or computational limits are reached
- Replace every agent in the simulation, or player in the game, in the same fashion





What Strategic Data Farming Makes Possible

- Increased fidelity of wargames and agent based simulations
- Replacing the players for full automation
 - Once it is impossible to “game the game” the computer can usually play the game better than a human can
 - Human creativity doesn’t matter to who wins game
 - Imagining meanings for chess moves never won the game
 - The player can not increase the ways to win the game, he can only eliminate consideration of non-human ways to win
 - If the problem is analysis, this will save human resources and make runs statistically significant
 - Only applicable to closed games (That only machines adjudicate)



Myths of Game Theory Techniques

- A game tree agent makes players act rationally while people are irrational in the real world
 - Game tree agents evaluate their environment according to their goals. These may be religious, or private
- Sometimes people just miss things or behave stupidly, but we are not exploring those instances
 - Game tree agents do not need to take poor moves into account in order to calculate how to win the game
- Game trees can not handle real world moves
 - Modern game tree technology can
 - Use heuristics to rank moves
 - Take into account simultaneous moves
 - Take perception into account
 - As in poker
 - Take probability into account



Summary

- Strategic Data Farming can perform validation and enable automation in agent based simulations and in wargame adjudicators
- Strategic Data Farming narrows the space of possibilities that need exploration in strategic games
- Strategic Data Farming does not limit human creativity in analysis anymore than the simulator itself does