

REPORT DOCUMENTATION PAGE

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AFOSR Project Final Report

Project Title: Deception Detection in Expert Source Information Through Bayesian Knowledge-Bases

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AFOSR Grant No. F49620-03-1-0014-06-1-0010

AFOSR PM: Dr. Robert Herklotz

Final Project Summary

Our goal in this effort was to automatically detect deception by an individual or expert who is contributing to an information knowledge-base consisting of multiple experts. Contemporary decision makers often must choose a course of action using knowledge from several sources. Knowledge may be provided from many diverse sources including electronic sources such as knowledge-based diagnostic or decision support systems, through data mining techniques, and so forth. As a decision maker's sources become more numerous, detecting deceptive information from these sources becomes vital to making a correct, or at least more informed, decision. This applies to unintentional misinformation as well as intentional disinformation. We have developed definitions for deception intent and potential mechanisms for capture such intentions and how to carry them out. We have also defined a number of concepts such as deception attempt, the deception core, effective deception and successful deception. A deception attempt occurs when the opinions returned to a decision maker by an expert agent are not those calculated by that expert agent with the given observations but are substituted to influence the decision maker's actions. The deception core refers to those opinions which are manipulated to form a deception attempt. An effective deception is a deception attempt which succeeds in altering the actions of the decision maker, though not necessarily to the actions desired by the deceptive expert. Finally, a successful deception is an effective deception in which the alternate actions which the decision maker chooses are those desired by the deceptive expert. We have focused on employing models of deception and deception detection from the fields of psychology, cognitive science and artificial intelligence and have implemented deception detection algorithms using probabilistic, intelligent, multi-agent systems. We have also conducted numerous experiments to explore and validate our approach.

Major Accomplishments

- We developed a framework to explore deception detection in all-source intelligence analysis processes.
- We developed a new algorithm and theoretical framework that supports sensitivity analysis and validation of Bayesian knowledge-bases central to deception detection.
- We conducted extensive and successful empirical studies to test our algorithms on multiple synthetic testbeds.

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- We defined a conceptual framework for modeling and capturing deception intent and how such deceptions are carried out within the framework of an adversarial course of action model.

Publications [1 journal article, 2 book chapters, 6 conference papers, 1 MS Thesis]
[The publications below were supported in full or in part by this project.]

Santos, Eugene, Jr. and Dinh, Hang T., "Automatic Knowledge Validation for Bayesian Knowledge Bases," *Data and Knowledge Engineering* 64, 218-241, 2008.

Yuan, Xiuqing, "Deception Detection in Multi-Agent System and War-Gaming," MS Thesis, Thayer School of Engineering, Dartmouth College, 2007.

Santos, Eugene, Jr. and Zhao, Qunhua, "Adversarial Models for Opponent Intent Inferencing," *Adversarial Reasoning: Computational Approaches to Reading the Opponents Mind* (Eds. A. Kott and W. McEneaney), 1-22, CRC Press, 2006.

Santos, Eugene, Jr., Zhao, Qunhua, Johnson, Gregory, Nguyen, Hien, and Thompson, Paul, "A Cognitive Framework For Information Gathering with Deception Detection For Intelligence Analysis," *Proceedings of the 2005 International Conference on Intelligence Analysis*, McClean, VA, 2005.

Thompson, Paul, Santos, Eugene, Jr., Zhao, Qunhua, Johnson, Gregory, and Nguyen, Hien, "Counter Denial and Deception and Utility-Theoretic Information Retrieval for Intelligence Analysis," *Proceedings of the 2005 International Conference on Intelligence Analysis*, McClean, VA, 2005.

Johnson, Gregory and Santos, Eugene, Jr., "Deception Detection in Information Systems I: Activation of Deception Detection Tactics," *Lecture Notes in Computer Science 3060: Advances in Artificial Intelligence – AI '04* (Eds. A. Tawfik and S. Goodwin), 339-354, Springer-Verlag, 2004.

Zhong, Xiaomin, Santos, Eugene, Jr., and McCartney, Robert, "Exploring the Relationship Between Knowledge and Algorithm Performance in Discrete Optimization," *Proceedings of the 16th IEEE International Conference on Tools with Artificial Intelligence (ICTAI 2004)*, 604-611, Boca Raton, FL, 2004.

Santos, Eugene, Jr. and Johnson, Gregory, "Toward Detecting Deception in Intelligent Systems," *Proceedings of the SPIE: Defense & Security Symposium*, Vol. 5423, 131-140, Orlando, FL 2004.

Santos, Eugene, Jr. and Dinh, Hang T., "Consistency of Test Cases in Validation of Bayesian Knowledge Bases," *Proceedings of the 16th IEEE International Conference on Tools with Artificial Intelligence (ICTAI 2004)*, 468-475, Boca Raton, FL, 2004.

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