

SUMMARY

Technical skills – Artificial Intelligence (AI) technology researcher and practitioner with particular focus on knowledge representation, human decision modeling and intelligent agent modeling. Practical experience in applying a multitude of technologies to real-world problems: natural language processing, data mining, machine learning, deep learning with neural networks, sentiment and opinion mining, social network analysis, and social media analytics. Working familiarity with a variety of programming languages (C, Java, Python, Clojure, Visual Basic, Prolog, Lisp), data and knowledge models (RDF/OWL, JSON, XML/XSL), query languages (SQL, SPARQL), programming methods (object-oriented, functional), and software project management methods (waterfall, agile, scrum, X programming).

Technical project management – Successfully led small development teams delivering customer success in the government and commercial sectors. In the government sector, led agile teams in transitioning applied research solutions to the Navy, Air Force, Army and intelligence community. In the commercial sector, led teams in building and customizing knowledge bases for enterprise-scale applications in the computer and telecommunications industries for Fortune 500 companies

Presentations – Excellent oral communication skills. Able to explain and distill complex technical concepts at the right level for a wide variety of audiences (peer researchers, customers in government and industry, current and potential stakeholders, and university student groups).

Publications – Excellent written communication skills (research papers and technical proposals). Publications have appeared in refereed journals and conferences. Research has appeared in invited workshops. Co-authored chapters in books on concurrent engineering and expert systems. Editor for a special issue devoted to configuration design. Publication list available separately.

WORK EXPERIENCE

Oklahoma Baptist University (www.okbu.edu), Shawnee, OK August 2020 – Present

Assistant Professor of Computer Information Science (August 2020 - Present)

Courses Taught – Computer Science I and II (Java), Software Projects I and II, Visual Programming (Visual Basic), Programming Language Concepts, Computer Systems Organization, Logic Design, Introduction to Programming (Python).

Knowledge Based Systems Inc. (www.kbsi.com), College Station, TX August 2007 – July 2020

Research Scientist II (November 2009 – Present); Research Scientist (August 2007 – October 2009)

Responsible for research and development for a range of government-sponsored programs. Research interests: decision modeling; course-of-action modeling and planning; multi-attribute utility theory decision support; social-network analysis; stochastic network modeling; quantum models for judgment and decision making; agent-based systems; and knowledge representation.

Clients: Air Force Research Laboratory, Army Research Laboratory, Edwards Air Force Base, Joint Warfare Analysis Center, Office of Naval Research. Detailed project descriptions available separately.

21st Century Technologies (<http://deumbra.com>), Austin, TX October 2004 – July 2007

Configuration Management Manager (April 2007 – July 2007); Principal Scientist - Asymmetric Threat Group (February 2006 – March 2007); Technical Lead (October 2004 – February 2006)

Responsible for IT operations configuration management at Tinker, AFB. Responsible for business development, proposal writing and technical leadership of a staff of fifteen software and research engineers.

Clients: Air Force Research Laboratory, Office of Naval Research. Detailed project descriptions available separately.

Trilogy Development Group (<http://trilogy.com>), Austin, TX March 1997 – July 2004

Program Manager, Senior Consultant, Technical Presales, Technical Lead (May 2004 – July 2004)

Responsible for technical leadership and direction of teams to build and customize knowledge bases for enterprise-scale applications in the computer and telecommunications sectors.

Timothy P. Darr, Ph. D.
timothy.darr@okbu.edu

Clients: NCR; Lucent; SGI; Herman Miller; Reynolds & Reynolds; Satyam Computer Services, Ltd., Bangalore, India; Hewlett Packard; Gateway; Sun Microsystems; Fujitsu Network Communications; Lucent Technologies. Detailed project descriptions available separately.

SERVICE ACTIVITIES

Member of Grove City College Computer Science Department External Advisory Board (2008 - 2019). Responsibilities included providing feedback on curriculum, offering feedback on department direction, and assisting in the Accreditation Board for Engineering and Technology (ABET) accreditation process.

Served on program committee for 6th, 7th, 9th and 10th International Conferences on Semantic Technologies for Intelligence, Defense, and Security. Responsibilities included reviewing paper submissions to the conference, providing commentary to authors and making accept / reject recommendations.

Active member of local non-denominational church where I have taught young adult and adult Sunday School classes, occasionally filled in the pulpit, served as church board chairman, and held a variety of roles at a summer youth / family camp (activities director, young adult teacher, high school teacher, kitchen staff, boy's dorm counselor).

EDUCATION

University of Michigan, Ann Arbor, MI

Ph. D., Computer Science and Engineering, 1997

Thesis: A Constraint Satisfaction Problem Computational Model for Distributed Part Selection

M. S. E., Computer Science and Engineering, 1992

B. S. E., Computer Engineering, Summa Cum Laude, 1988

PATENTS

Timothy P. Darr, Raymond L. Beaumont and Nirad P. Sharma. Product Configuration Using Configuration Patterns. U.S. Patent 7,188,335, issued March 6, 2007.

Timothy P. Darr, Thomas H. Dillon, Sherrill J. Packebush, Michael K. Grant, James Singh, Jacob D. Leffler, Jeremy S. Wacksman and Neil C. Thier. Retail Recommendation Domain Model. U.S. Patent 7,698,170, issued April 13, 2010.

Nirad Sharma, Michael K. Grant, Neil C. Thier, Alex Devine, Sherrill J. Packebush, Thomas H. Dillon, James Singh, Jeremy S. Wacksman, Chris Hyams and Timothy P. Darr. System and Method for Generating Effective Recommendations. U.S. Patent 7,720,720, issued May 18, 2010.

Timothy P. Darr, Social Network Aware Pattern Detection, U. S. Patent 7,856,411, issued December 21, 2010.

PUBLICATIONS

Hancock, B. J., Darr, T. P., Hazell, R., Grazaitis, P., "Integrating Civil Affairs Through the Application of Battlefield Relevant Civil Information Management," *Civil Affairs Association Issue Papers (to appear)*, 2019.

Darr, T. P., Mayer, R., Jones, R. D., Ramey, T., Smith, R. and Zimmerman, C., "Quantum Probability Models for Decision Making," in *24th International Command and Control Research & Technology Symposium*, Laurel, MD, 2019.

Houser, D., Wang, J., Darr, T. P. & Mayer, R., (2019). Time pressure improves decisions in generalized Colonel Blotto games. *24th International Command and Control Research & Technology Symposium*. Laurel, MD

Darr, T.P., Benjamin, P. and Mayer, R., "A Utility-Theoretic Preference Model for OPFOR Course-of-Action Selection and Assessment", *HSCB Focus 2011: Integrating Social Science Theory and Analytic Methods for Operational Use*, February 8-10, 2011.

- Darr, T. P., Benjamin, P. and Mayer, R., "The Application of a Course-of-Action Ontology to Support OPFOR COA Selection and Assessment", *6th International Conference on Semantic Technologies for Intelligence, Defense, and Security (STIDS 2010)*, George Mason University, November 15-18, 2010
- Darr, T. P., Benjamin, P. and Mayer, R., "Course of Action Ontology for Counterinsurgency Operations", *15th International Command and Control Research and Technology Symposium (15th ICCRTS)*, Santa Monica, CA, June 22 - 24, 2010.
- Darr, T. P., Benjamin, P. and Mayer, R., "Course of Action Planning Ontology", *Ontology for the Intelligence Community Conference (OIC 2009)*, George Mason University, October 21-23, 2009
- Darr, T.P., et. al., "Verification, Validation and Completeness Support for Metadata Traceability", 46th Annual International Telemetry Conference (ITC 2010), San Diego, CA.
- Darr, T.P., et. al., "Semantic Web Technologies for T & E Metadata Verification and Validation", 45th Annual International Telemetry Conference (ITC 2009), Las Vegas, NV.
- Darr, T.P., Fernandes, R., Graul, M., Hamilton, J. and Jones, C., "Automated Configuration and Validation of Instrumentation Networks", 44th Annual International Telemetry Conference (ITC 2008), San Diego, CA.
- Hamilton, J., Fernandes, R., Graul, M., Darr, T.P. and Jones, C., "Extensions to the Instrument Hardware Abstraction Language (IHAL)", 44th Annual International Telemetry Conference (ITC 2008), San Diego, CA
- Darr, T. P., Greenblatt, S. and Marcus, S., "TMODS – Integrated Fusion Dashboard – Applying Fusion of Fusion Systems to Counter-Terrorism", *2005 International Conference on Intelligence Analysis*, May 2-6, 2005, McLean, VA.
- Darr, T. P. and Birmingham, W. P., "Part-selection Triptych: A Representation, Problem Properties and Problem Definition, and Problem-solving Method", *AI EDAM*, Vol. 14, No. 1, 2000, pp. 39-52.
- Darr, T. P., Klein, M., and McGuinness, D. L. (eds.), "Configuration Design", *AI EDAM Special Issue: Configuration Design*, Vol. 12, No. 4, 1998, pp. 293-294.
- Darr, T. P., and Birmingham, W. P., "A MAD approach for solving part-selection problems", in *Proceedings of 5th International Conference on Artificial Intelligence in Design (AID'98)*, July 1998, Lisbon, Portugal.
- D'Ambrosio, J., Darr, T. P., and Birmingham, W. P., "A Constraint Satisfaction Approach for Multi-Attribute Design Optimization Problems", in *Proceedings of DETC'97: 1997 ASME Design Engineering Technical Conferences*, September 1997, Sacramento, CA.
- Darr, T. P. and Dym, C. L., "Configuration Design: An Overview", *The Handbook of Applied Expert Systems*, CRC Press.
- Darr, T. P. and Birmingham, W. P., "An Agent Architecture and Algorithm for Solving Distributed Configuration-Design Problems", *AAAI Fall Symposium on Configuration*. The MIT Press/AAAI Press.
- Birmingham, W. P., D'Ambrosio, J. and Darr, T. P., "Hierarchical Concurrent Engineering", in *Advances in Concurrent Engineering (CE-96)*, August 1996, Toronto, Ontario. pp. 129-136.
- D'Ambrosio, J., Darr, T. P. and Birmingham, W. P., "Hierarchical Concurrent Engineering in a Multiagent Framework", *CONCURRENT ENGINEERING: Research and Applications*, Special Issue on: The Application of Multi-agent Systems to Concurrent Engineering, Vol. 4, No. 1, March 1996, pp. 47-57.
International Society for Productivity Enhancement, Best Paper Award.
- Darr, T. P. and Birmingham, W. P., "An Attribute-Space Representation and Algorithm for Concurrent Engineering", *AI EDAM*, Vol. 10, No. 1, 1996, pp. 21-35.

- Darr, T. P. and Birmingham, W. P., "A Case Study in Design Service Integration", in *Concurrent Engineering: A Global Perspective (CE-95)*, August 1995, Washington, D. C. pp. 409-415.
- Birmingham, W. P., Darr, T. P. and Schreiber, A. Th., "VT-Sisyphus: A Synthesis", *The 9th Banff Conference on Knowledge Acquisition, 1995*.
- Darr, T. P. and Birmingham, W. P., "Automated Design for Concurrent Engineering", *IEEE Expert*, Vol. 9, No. 5, October 1994, pp. 35-42.
- Birmingham, W. P., D'Ambrosio, J. G., Darr, T. P. and Durfee, E., "Coordinating Decision Making in Large Organizations", *AAAI 1994 Spring Symposium: Computational Organization Design*, March 1994.
- Birmingham, W., Darr, T., Durfee, E, Ward, A. and Wellman, M., "Supporting mechatronic design via a distributed network of intelligent agents", *AAAI-93 Workshop Notes on AI in Collaborative Design*, July 11-15, 1993, Washington, D. C., pp. 15-34.
- Darr, T. P. and Birmingham, W. P., "Concurrent Engineering: An Automated Design-Space Exploration Approach", in *Concurrent Engineering: Methodology and Applications*, P. Gu and A. Kusiak (Editors), Elsevier, 1993, pp. 91-115.

PROJECT HISTORY

Knowledge Based Systems Inc., College Station, TX

August 2007 – July 2020

Principal Investigator Projects

For the following projects, I wrote the initial business proposal for the research and managed day-to-day operations.

KBSI Civil Affairs Social Media Monitor for DUE Resilience (K-CASM)

Army Research Lab

September 2019 – present, Phase I SBIR Contract # W911QX-19-P-0157, \$108,000

Dense Urban Environments (DUE) are characterized by large concentrated populations that tend to cluster into groups networked together by common interests and needs. Populations cluster along political, social, cultural, ethnic, economic and other social lines. Networks among these groups, formed along lines of shared characteristics, are often in friction with one another as they contend over scarce structural or functional resources (water, food, housing, information, legitimacy, etc.).

Stresses along one dimension (social or structural) can propagate to other dimensions, leading to unintended or unanticipated 2nd and 3rd order effects. Accurately forecasting the response to stressors, including 2nd and 3rd order effects, is extremely difficult. Effective forecasts can enable analysts and planners to assess social and structural resilience within a DUE.

The "KBSI Civil Affairs Social Media Monitor for DUE Resilience" (K-CASM) will extend the current state of the art DUE resilience models by developing mathematical models of how human make decisions and its effects on the multiple interconnected networks of a DUE. The output will be forecasts of sentiment and community behavior.

Mega-City Analysis and Visualization Environment (M-CAVE)

Army Research Lab

September 2017 – December 2018, Phase I SBIR Contract # W911QX-17-P-0234, \$149,999

September 2018 – present, Phase II SBIR Contract # W911SR-18-C-0039, \$999,903

The "Mega-City Analysis and Visualization Environment" (M-CAVE) technology will provide users with advanced yet simple-to-use influence models, methods, and visualization to help Civil Affairs teams assess, comprehend, and shape influence operations and their outcomes. Particular emphasis of the M-CAVE project is on dense urban environment (DUE) applications. DUEs are characterized by large, concentrated populations, explosive population growth, and increased potential for social volatility. Success in DUE missions depends on effective understanding of and operation in the human domain. Influence modeling is a method for understanding the human domain that extends social networks by

explicitly modeling beliefs and judgments of actors. Influence modeling provides predictive capability for COP situational awareness, link analysis, COA comparison and forecasting effects of actions. The M-CAVE visualization method and tool augments standard COP layers with user-defined PMESII-PT / ASCOPE overlays. PMESII-PT / ASCOPE variable assessment is informed by M-CAVE influence models and social media analytics

Positive and Negative Inference Models for Intelligence Planning and Assessment (PaNIMI)

Office of Naval Research

September 2016 – November 2019, Contract # N00014-15-R-BA010, \$1,499,810

Research has demonstrated that human judgment and decision making is sometimes enigmatic; that is, there are situations in which human decision making deviates from classical probability and utility models. Examples include: sunk cost fallacies, anchoring, availability heuristics, Halo effects, group think, bandwagon effects, etc. Not only do our own decisions suffer from this condition, but more importantly, the actions of other actors are often hard to predict or interpret. In an atmosphere of uncertainty and lack of consensus, decisions by the various actors in a situation may seem irrational and ambiguous.

In recent years, the mathematics of quantum probability theory has proven well suited to effectively modeling some of the enigmatic human decision making behavior. Similar to its application in physics, quantum probability theory allows the analyst to model multidimensional features in the decision space. Decisions-to-act are represented as wave functions over these features. Interference among these wave functions model observed enigmatic behaviors.

We posit that an application of quantum probability theory to decision modeling and simulation will lead to clearer and more substantial understanding of the environment and better situation awareness. In this project, we develop practical methods and tools for applying the mathematics of quantum probability to understand, explain and predict human decision-making behavior. These methods and tools are validated in the context of several operational use cases including enemy course of action analysis.

Simulation in Behaviors and Decisions (SinBaD)

Office of Naval Research

April 2018 – October 2018, Phase I SBIR Contract # N68335-18-C-0337, \$125,000

The Simulation in Behaviors and Decisions (SinBaD) project employs advanced AI methods to develop autonomous Red and Blue agents (by modeling or by learning). A catalog of tendency or decision-making models, or *moremes*, represents the judgments, beliefs and cognitive biases that humans often exhibit in decision-making situations. Moremes are used to model decision making during engagements between simulated agents within a larger decision-making scenario. Parameters of the moremes can be tuned to achieve “fair fights”. A theory of how a situation assessment interacts with action options models agent decision making. The decision-making of an agent about whether or not to act can be influenced by another agent by introducing uncertainty into the opponent’s assessment of a situation.

Data collected from model based simulated engagements (or actual human players of the game) are used to train neural networks that learn the decision making of autonomous agents. A novel application of the Style-Transfer Generative Adversarial Network (STGAN) is used to train neural networks that can then be used for autonomous agents. This method learns specific agent tendencies and decision calculi at an individual battlefield by watching thousands of “games” played between the modeled smart agents or actual human player. The resulting trained nets can be used as autonomous agents in agent vs. agent or human vs. agent simulation, training, or as a decision aid to support course-of-action analysis, CONOPS validation, and other use cases.

Principal Investigator – Verification and Validation of Metadata for Test and Evaluation (VIVALDI)

Edwards Air Force Base

May 2014 – February 2015, Phase I SBIR Contract # FA9302-14-M-0001, \$70,000

September 2016 – May 2019, Phase II SBIR Contract # FA9302-16-C-0008, \$750,000

The VIVALDI method and toolkit enables test and instrumentation engineers and T&E stakeholders to define rules and support the verification, validation, de-confliction and optimization (VVDO) of metadata and systems design relating to multi-vendor test and instrumentation systems. This capability includes the following innovations: a catalog of rules for supporting T&E VVDO that can be used in multi-vendor, multi-range environments; machine understandable and standards based representation of the rule catalog; a controlled natural language for rule capture and translation of the CNL to target rule representation; and an API to support rule representation and evaluation.

Principal Investigator – Query Language for Analytic Product Support (QLAPS)

Office of Naval Research

October 2012 – April 2013, Phase I SBIR Contract #N00014-13-M0031, \$80,000

The tremendous amount of information available to the analyst is both an opportunity and a problem. Clearly, more information provides analysts with a better foundation for their analyses. However, as the amount of information increases, analysts are finding it more and more difficult to take advantage of the wealth of information, due to difficulty in picking out the information that they need at the time that they need it, in order to produce actionable intelligence to assist planners and warfighters. Knowledge Based Systems, Inc. (KBSI) proposes to conduct research leading to a “Query Language for Analytic Product Support” (Q-LAPS) that enables analysts to effectively query unstructured and semi-structured data sets for information that is relevant and timely for generating analytic products. The proposed approach strikes a balance between the need for high quality and accurate results and ease of use and minimal training for the analyst.

Principal Investigator – Multi-Source Network Pulse Analyzer and Correlator (MiNPAC)

Army Research Laboratory

March 2011 – August 2011 Phase I SBIR Contract #W911QX-11-C-0061, \$100,000

September 2012 – June 2015, Phase II SBIR Contract # W911QX-12-C-0117, \$750,000

The MiNPAC capability to sense and identify emerging topics within social media and networks provides insight into what is most interesting to people within a region or a group who are using social media and networks. It shows what they are talking about amongst themselves and in "private" conversations. Specifically, it identifies new topics of interest as people begin to introduce and discuss new conversational subjects. By becoming familiar with what people are talking about the most and which developing subjects become topics of interest, an analyst—over time—can begin to sense which emerging topics are going to be important to the targeted group. This then provides insights into *the group*—what they are talking about, what is being said specifically, what is important to them, what they think about the topic, who is influential in the conversation, who are the leaders, and who are the followers.

The MiNPAC capability to track topics and sentiment over time as topic and sentiment signals provides insight regarding how groups of interest view a specific topic or topics over time. Additionally, in certain cases, some of the topics and sentiments discovered will be used as "signals" that indicate something of special interest is happening and some of the signals might be significant enough to cross a threshold that would then elicit specific responses or actions. Those specific signals would act as alarms.

The MiNPAC capability to characterize the underlying system dynamics and to correlate changes in topic and sentiment with changes in the underlying social network helps to isolate whether certain sentiments are dominant within certain groups and how ideas ebb and flow within the groups. It might show differences in attitudes according to region, age, economic or political group. It gives further insight into how targeted groups think and how they might be influenced.

The MiNPAC technology will provides innovative new capabilities that will help field commanders rapidly and reliably perform COA planning. These capabilities will significantly reduce the time and effort needed to convert distributed data into action enabling information for decision making in the dynamic environments that characterize today’s asymmetric conflicts.

Principal Investigator – Adapting the ModelMOSAIC® Toolkit for ISR-C2 Intelligence Rapid Product Generator (iRPG)

Office of Naval Research

November 2010 – March 2015 Contract #N00014-10-C-0379, \$2,376,000

iRPG provides analysts with a suite of innovative tools for constructing *product generation templates*, or workflows, and instantiating these product generation templates to support authoring of a variety of analytic products (Daily INT SUM, HVI Report, KLE Report, etc.). The ModelMosaic® WORKFLOW STUDIO and iRPG WORKFLOW SUITE™ applications provide analysts with the capability to define product generation templates to define data flow and build new knowledge from disparate analytics (entity extraction, topic extraction, social network extraction, sentiment extraction, semantic tagging, etc.). The workflow technology is the “under the hood plumbing” that orchestrates the on-demand flow of data from original sources through disparate analytics to condition and augment the data to final processed data that can be included in a finished intelligence product. The resulting capability for rapid generation of intelligence products will enable warfighter-evolved systems; that is, users will be able to compose solutions to intelligence needs in real time using pre-existing data sources and services. The iRPG suite decreases the time and cost of defining, deploying and executing

an analytic workflow. The iRPG technologies enable automation of advanced data analytics for rapid identification and dissemination of time-critical information.

The iRPG will be a standards-based framework, making use of the service-oriented architecture (SOA), and supporting distributed data models and ontologies. The resulting iRPG will include the following features: 1) a knowledge product ontology derived from intelligence product requirements; 2) a set of design integration guidelines for application services; 3) implementations of workflow and discovery services; and 4) a method for annotating non-semantic web services and other analytics for integration into the iRPG framework.

Principal Investigator – Process Mining for Entity Association Disambiguation (PMEAD)

Office of Naval Research

October 2010 – April 2011, Phase I SBIR Contract #N00014-10-M-0438, \$70,000

The objective of the *Process Mining for Entity Association Disambiguation (PMEAD)* capability is to improve the quality, fidelity, and utility of large-scale sensor observation data stores derived from real-world data. The PMEAD approach is directed to large-scale RDF graphs and will employ semi-automated provenance generation, process mining, sequence mining, and other data mining methods. PMEAD will define rules that can be used to identify redundant and missing statements within entity association RDF graphs.

Principal Investigator – Message Epidemiology Resource for Counterinsurgency (MERCURY)

April 2009 – October 2009

Office of Naval Research Phase I SBIR Contract #N00014-09-M-0219, \$70,000

Knowledge Based Systems, Inc.'s (KBSI) MERCURY project provides a suite of capabilities for an HSCB (Human Social Culture Behavior) *media sensor*. The MERCURY HSCB media sensor monitors a media input source, such as a blog, chat room, or forum, and computes a *social science metric vector* that measures features of the social science theory. MERCURY provides support for HSCB influence operation (IO) activity planning and execution by understanding and measuring the effectiveness of the cultural response of a target audience to a media-based IO activity. The MERCURY ontology includes definitions of measures-of-performance (MOP) and measures-of-effectiveness (MOE), based on social science metrics, that are tied to activities within a course-of-action plan or logical line of operation.

Principal Investigator – Hidden Enemy Network Influence Operations Map (HENIOMAP)

June 2009 – March 2014

Office of Naval Research Contract #N00014-09-C-0334, \$1,700,000

The HENIOMAP™ tool is a web-based COA assessment tool that provides a planner or planning staff a simple, quick, flexible, and effective way to define, review, and evaluate various COA/task options to determine which options offer the best opportunities to achieve a particular objective. It provides the foundation for a decision-maker to select a COA that most effectively evaluates applicable attributes (feasibility, flexibility, risk, etc.) against each other to achieve the objective.

The HENIOMAP™ tool is important in that it provides planners with a structured way to think through the most promising alternatives for how the commander's objective(s) can be met, as well as a repeatable, verifiable process using a simple mathematically-based tool to better access and compare qualitative judgments. The HENIOMAP™ technology can be applied to any COA assessment problem and can be used to predict potential enemy countermoves.

The HENIOMAP™ tool provides a model of commander objectives, COAs, and attributes that allows a planning staff to *evaluate* the effects of a COA against standardized assessment attributes (feasibility, risk, etc.) or tailored assessment attributes independently developed by the planning staff. The HENIOMAP™ tool provides a method for capturing assessment attribute trade-offs in a preference model that allows a planning staff to *recommend* possible COAs that are consistent with the preferences from one or more perspectives.

Project Manager Projects

For the following projects, I managed day-to-day operations.

Controlled Natural Language-based Knowledge Inter-exchange Network (CKI-NET)

September 2014 – Present

Office of Naval Research Contract # N00014-14-C-0196

CKI-NET directly addresses the key challenges outlined as part of the Navy's 2025 vision of a data-centric cloud architecture. The challenges CKI-NET will address are “minimizing the intelligence analysts’ efforts to specifically direct or request information on a particular need by the warfighter, reducing the manpower required to analyze the raw data and to produce a fused, full vetted intelligence assessment to the commander to maintain dominance in what is called the OODA Loop.” Aiding the commander in staying “inside” the oppositions decision loop is the goal. CKI-NET makes use of controlled natural language (CNL) in conjunction with system wide ontologies as the primary communication scheme to exchange information between the warfighter and intelligence service providers across nodes in the network.

The CKI-NET project addresses the following main objectives:

- Automated scheduling and coordination of sensors that provide collection and production of intelligence.
- Automated processing of sensor data at or near the sensor resulting in usable intelligence.
- Automated and timely routing of requests for the collection and production of intelligence.
- Graceful degradation of communication within the CKI-NET communications network

Research Scientist – Intelligent System for Abstraction and Integration of Instrumentation Hardware (ISAIH)

August 2007 – October 2012

Contributions: co-developed XML-based Instrumentation Hardware Abstraction Language (IHAL) schemas for describing instrumentation network hardware and systems; developed a constraint-satisfaction problem (CSP) based configuration engine for configuring an instrumentation system, given a set of requirements in the form of test measurands.

Research Scientist – Framework for Intelligent Support of Smart Transducers (FIST)

August 2007 – August 2011

Contributions: applied the IEEE 1451 smart transducer standard to the validation and verification of aircraft test instrumentation systems; designed and developed a component-based architecture for automated configuration of IEEE 1451 compliant systems.

Research Scientist – Post-Deployment Software Maintenance (PDSM)

August 2007 – February 2008

Contributions: researched and prototyped constraint-based systems for parametric model estimation applied to the domain of software lifecycle maintenance.

Research Scientist – Data Display Translation Framework (DDTF)

August 2007 – December 2007

Contributions: developed a user-configurable XML-based utility for converting a TeleMetry Attributes Transfer Standard (TMATS) test results specification into the vendor-neutral Data Display Markup Language (DDML) format for display in any DDML-compatible display tool.

21st Century Technologies, Austin, TX

October 2004 – July 2007

For the following projects, I wrote the initial business proposal for the research and / or managed day-to-day operations.

Technical Team Lead – Multi-Intelligence Network Models for Threat Prediction

US Air Force Research Laboratory, Rome, NY. Contract # FA8750-04-C-0237

Military commanders need up-to-the-minute intelligence about enemy threats, which makes the development of expanded and improved Multi-INTelligence (Multi-INT) capabilities a prerequisite for their success. As such, the Multi-INT community is actively developing new technologies to facilitate the identification and targeting of new and emerging threats. These threats can be manifested in network-centric forms of organization, strategies, doctrines, and technologies attuned to the information age. An example of an enemy threat is a terrorist activity and is likely to consist of dispersed organizations, small groups, and individuals who communicate, coordinate, and conduct their campaigns in a network-like manner, often without a precise central command. These threats are more likely to be caused by Al Qaeda or Hamas than the PLO who have known leaders and infrastructures. Our major technical focus is network-based model development for the prediction of threats as they apply to dynamic and evolving operational environments.

Technical Team Lead – Automated Detection, Identification, and Tracking of Deceptive Terrorist Activity

US Air Force Research Laboratory, Rome, NY. Contract # F30602-03-C-0004

The scope of this effort includes: modeling the flow of terrorist network exploiting social network capabilities, developing algorithms to identify growth or changes as terrorist networks evolve, identifying support structure, and providing real-time modeling capabilities of these functions.

Technical Team Lead – Strategic Effects-based Objective Approach to Determine the Likelihood of Possible Terrorist Attacks (AVIAT Phase II)

DOI, NBC, Fort Huachuca, AZ. Contract # NBCHC050050

This Phase II AVIAT proposal consists of seven major objectives. The first objective will develop a powerful and robust infrastructure and vulnerability reasoning system that allows officials at all levels of government to assess infrastructure security status. In particular, quantitative measures of priority, criticality, impact, and ease of exploitation with respect to threats and vulnerabilities of infrastructures will be developed, instead of relying upon qualitative assessments. The second objective is to create a rapid knowledge formation system and extend the Phase I AVIAT ontology models so that infrastructure information can be captured from multiple states. Upon completion of this objective, AVIAT will have the ability to acquire national infrastructure data to form a comprehensive AVIAT Infrastructure Ontology. The third objective is the integration of AVIAT with TMODS/SNA that will provide a more complete solution with the ability to insert actual evidence of terrorist activity and to incorporate what is learned from AVIAT into TMODS patterns. The fourth objective will provide the capability to automatically update knowledge in AVIAT with other data sources including DHS and the integration mechanisms to enable this level of integration. The fifth objective includes rudimentary integration mechanisms to other systems of interest (i.e., GIS information, bomb physics, and air dispersion modeling). The sixth objective will extend the capability of Technical Objective 2 by providing the ability to retrieve infrastructure data from textual descriptions of infrastructure—a major source of information for building real-world infrastructure ontologies. The seventh objective will provide the awareness and successful transition of AVIAT technology into federal agencies, other states, and potential commercial partners by aggressively demonstrating and inserting the technology.

Principal Investigator – Terrorist Modus Operandi Detection System

US Air Force Research Laboratory, Rome, NY. Contract # FA8750-04-C-0237, P00002

Provide new and emerging technologies in the areas of SNA-based event detection, multi-resolution graph matching in the context of streaming data, and the fusion of terrorist detectors to enhance situational awareness. Each of these technical elements will provide a framework for next generation terrorist detection systems at the Department of Homeland Security.

Principal Investigator – Data cleansing to support the Multi-INT agent architecture

US Air Force Research Laboratory, Rome, NY. Contract #FA8750-05-C-0206

Information extraction from open-source documents is an essential requirement for building robust, non-brittle and up-to-date intelligence analyst support systems. The amount of data that is available or of interest to an analyst makes manual knowledge acquisition prohibitive. The process of extracting information from unstructured text is theoretically challenging and computationally expensive. There exist myriad systems that focus on the task of information extraction with varying degrees of accuracy and completeness. What is often missing from these systems is the capability to normalize and consolidate the data, keeping it consistent, relevant and up-to-date. Attaining these capabilities, which we will refer to jointly as *data cleansing*, is essential for creating a knowledge base that is reliable, readable, and otherwise useable by the intelligence community. Information extraction is concerned with “translation” from the input text format, and therefore requires detailed knowledge of linguistic grammars, sentence structure, as well as domain knowledge necessary to process input texts. Data cleansing, on the other hand, is a knowledge-centered activity within the scope of the knowledge base, which is concerned with providing concept normalization and identity uniqueness, as well as maintaining concept relevance.

Principal Investigator – Algorithmic Tools for Adversarial Games (Game-Theoretic TMODS)

US Air Office of Scientific Research, Arlington, VA. Contract #FA9550-05-C-0062

21st Century Technologies, Inc. (21CT) and the University of Michigan (UM) propose the development and validation of Game-Theoretic Terrorist Modus Operandi Detection System (GT TMODS) to produce a truly innovative, next generation DoD strategy selection technology with respect to asymmetric threats against politically, culturally, and socially diverse adversaries. GT-TMODS will integrate state-of-the-art game theory and simulation research from UM with proven, powerful graph-matching and Social-Network Analysis (SNA) methods to model and detect asymmetric

threat activities through multi-agent adversarial games. This research is innovative in its approach because of the capabilities in GT-TMODS including: (1) culturally based game-theoretic models of the asymmetric threat, (2) empirical game-theoretic analysis of the asymmetric threat, (3) approximate solutions for intractable games identifying plausible threat strategies and profiles, (4) graph-based threat patterns and SNA signatures derived from the game-theoretic simulation and analysis, and (5) analysis of politically, socially, and culturally diverse adversaries. GT-TMODS will provide sophisticated technology to a wide audience of potential users in the military and intelligence communities for enhanced national security against asymmetric threats resulting in significant improvements in our response capabilities against politically, socially, and culturally diverse adversaries. GT-TMODS will have a wide range of important defense and commercial applications including terrorist threat detection, industrial espionage detection, financial fraud detection, and business intelligence.

Co-Principal Investigator – Comprehensive, Advanced Vulnerability of Infrastructure Assessment Tool
US Army Aviation and Missile Command, Redstone Arsenal, AL. Contract #W31P4Q-06-C-0030

21st Century Technologies, Inc. (21CT), leveraging our expertise and experience in graph-based pattern matching, threat/vulnerability assessment and our team of experts propose CAVIAT, a Comprehensive and Advanced Vulnerability of Infrastructure Assessment Tool. CAVIAT is an *intelligent agent-based architecture* that will produce a truly innovative, next generation DoD technology to *improve the ability to rapidly capture, assess, reason, and generate alerts about threats and vulnerabilities for highly inter-related military infrastructures*. CAVIAT is based on integrating *agent-based reasoning* with 21CT's proven expertise in *graph pattern matching*—a unique innovation of distributed, hierarchical, exact and inexact graph pattern matching. In this representation, a graph represents threat and vulnerability knowledge of specific military installations and a graph pattern represents hypotheses of threats and vulnerabilities associated with a certain type of military infrastructure. A matched pattern represents an actual threat or vulnerability associated with a set of military infrastructures. Agent-based reasoning technologies assess and reason about the threat or vulnerability by analyzing context of the matched pattern from the graph. Knowledge capture will be performed using Protégé, an ontology capture editor, developed by Stanford University.

Trilogy Development Group, Austin, TX

March 1997 – July 2004

Program Manager – Trilogy Enterprise Solutions (May 2004 – July 2004)

Client(s): NCR, Lucent, SGI, Sun, Herman Miller, Reynolds & Reynolds

Modeling Lead Trainer (March 2004 – April 2004)

Client(s): Satyam Computer Services, Ltd., Bangalore, India

Presales Support (June 2003 – February 2004)

Client(s): Hewlett Packard, Gateway

Product Configuration Modeling (May 2002 – June 2002, November 2002 – May 2003)

Client(s): Sun Microsystems

Senior Consultant (July 2002 – September 2002)

Client(s): Fujitsu Network Communications

Program Manager / Application Developer – Trilogy COMPASS™ (October 2001 – April 2002)

Client(s): Telecommunications optical networking OEMs

Senior Consultant (June 2001 – September 2001)

Client(s): Fujitsu Network Communications

Presales Support (March 2001 – May 2001)

Client(s): Lucent Technologies

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