

John T. Carrola Jr.

Artificial Intelligence Solutions Architect Lead

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Booz Allen Hamilton (April 2021—Present)

Southwest Research Institute (SwRI), Applied Physics Division—19 Years of Experience

Science & Technology Innovator / Program Development / Multidisciplinary Teambuilding

**Specialist,
Communications,**
2002–2006

**Specialist, Learning
Sciences & Systems,**
2007–2011

**Research Analyst,
Applied Physics,**
2011–2021

**Artificial Intelligence Solutions
Architect Lead, Booz Allen,**
2021–Present

Mr. John Carrola is currently an Artificial Intelligence and Deep Learning Solutions Architect at Booz Allen Hamilton (BAH), and a technical lead for the Digital Transformation Team. Current work in this area centers on developing learning models for automating assessments through analysis and model integration within data-driven pipeline ecosystems.

He is also leveraging his experience in applying all-source intelligence to structure information into data-driven graph-based frameworks for intelligence analysis of the Information Environment: identifying intelligence gaps and anomalies, understanding mis/disinformation dynamics, modeling defensive and counter techniques for influence operations, and creating audience analysis models.

At SwRI Mr. Carrola was an applied mathematics and data research analyst in the Applied Physics Division's Systems and Sensors Section. There he specialized in conducting research aimed at modeling, mining, and analyzing information from diverse data sets. Other research experience and responsibilities include: engineering collection and analysis techniques, building research teams, and integrating ideas from multiple disciplines to investigate new scientific research.

His experience focuses on investigating and applying creative perspective and mathematical techniques to accomplish technical innovation and design general solutions to various problems.

Mr. Carrola routinely manages as well as performs experimental work and data analysis with his research teams, along with creating and communicating new ideas. This includes experience in designing and programming applications to analyze data using statistical packages and toolsets in MATLAB, Python and R among other languages.

His project work includes the conceptualization and development of original funded research in a variety of scientific fields for agencies including: the Defense Advanced Research Projects Agency (DARPA), the U.S. Army Research, Development, and Engineering Command (RDECOM), Air Force Installation and Mission Support Center (AFIMSC), North Atlantic Treaty Organization (NATO), and Southwest Research Institute's Disruptive Technology Internal Research and Development (DTIR&D) Program.

RESEARCH AND TECHNICAL EXPERIENCE

- OSINT / social science support
- Machine learning / machine vision
- Natural language processing
- Data mining / data science
- Statistical & experimental methods
- National security / intelligence analysis
- Trend analysis & forecasting
- Culture / group dynamics
- Mis-/disinformation
- Mathematical modelling & simulation
- Cognition / emotions
- Identity / personas
- Uncertainty & risk modelling
- Anomaly detection
- Threat assessment

PROFESSIONAL, ANALYTICAL, AND METHODOLOGICAL SKILLS

- Algorithm Development: Matlab, R, Python, Java, C#
- Application Development: Java, C#, Android platform
- Graphics/Video Design: Adobe Creative Suite
- 3D / Real Time Graphics: 3D Max, Autodesk Revit & ReCap, Unity3D, OpenGL
- Supervised, unsupervised, deep learning models
- Social analysis / structured analytic techniques
- Linear, longitudinal / multilevel, game-theoretic statistical models
- Model evaluation /selection /optimization
- Experimental, survey, observational, interview design & methodologies
- Modelling, Simulation and Digital Twin design
- Feature engineering
- Web scraping / API requesting
- Data visualization
- Theory construction / testing
- Research participant management
- Program planning and evaluation
- Proposal & technical report writing

CLEARANCE OR CITIZENSHIP

ACTIVE SECRET CLEARANCE

ACADEMIC SCHOLARSHIPS OR SPECIALIZED PROGRAMS

University of Texas at San Antonio (UTSA) Intelligence Community Centers for Academic Excellence (ICCAE) Scholar recipient 2018-2020

RECOGNITION

NATO Innovation Challenge (Innovation Hub):

- **Military Mobility (Second place winner; November 2023)** Solution Architect and Technical Lead
- **Multi-Domain Resilience (Finalist (4th); October 2022)** Solution Architect and Technical Lead

NATO Defense College (NDC) Competition – NATO 2099: A Graphic Novel:

- **Selected Work (2023).** Fictional Intelligence / Sci-Fi Short Story Contribution

EDUCATION

- M.S., Data Analytics (National Security / Intelligence Studies Track), University of Texas-San Antonio, 2020
- B.S., Mathematics, Texas A&M University-San Antonio, 2012
- B.A., Communication Arts (Graphics / 3D Visualization Track), University of the Incarnate Word, 2001

RELEVANT RESEARCH & EXPERIMENTAL WORK

AI-Driven CAD/Revit Automation from LiDAR Point Clouds (2023–Present):

Mr. Carrola is leading the technical and strategic development, of an AI-enabled solution to automate CAD and Revit design floorplans from LiDAR point cloud data, significantly enhancing efficiency from data capture to final floorplan draft to Building Information Model (BIM) reducing manpower ("capture once, use many"):

- **Developed new ML models and AI techniques:** Designed core algorithms that achieved a minimum 40% reduction in time and cost by autogenerating Revit drawings from point clouds using AI Computer Vision and Revit API.
- Developed and **directed the implementation of Robotic Process Automation (RPA)** to reduce point cloud processing time by 90%.
 - Led the design to convert raw scans into RCP and relevant filetypes using RPA, streamlining the initial data processing phase.
 - Designed the workflow, integrating the files to generate custom data structures for AI-driven wall placement in Revit
- Architected an **AI Computer Vision system** (including developing feature engineering transforms and image processing algorithms) to automatically identify and populate annotation drawing data for model training, including space types, and architectural features from the LiDAR point cloud data.
- **Established user involvement strategies** for successful product deployment, incorporating training, testing, and usage tracking to align the product with operational requirements
 - Implemented metrics and analysis frameworks to track performance, identify areas for improvement, and inform model tuning for handling high noise/high variance scan data
- **Directed data curation and analysis efforts**, including the development of helper tools to standardize data quality for model inputs, ensuring better and more reliable results (e.g., 3D point cloud data transforms; point cloud optimizations for processing >90K sq ft buildings; graph-based approaches for CAD processing)

- **Conceptualized and directed the development of the Revit Wall Placement Plugin**, which converts the scans and data from the other workflows to Revit (CAD) space, to create walls for each floor
- Instituted a methodology for **assessing and improving scan quality** to mitigate the impact of variable scan density on results and establish a deep learning training pipeline for labels and mask generation.

ARMY P2MR2 Modernization & SecureRAG: Multi-Domain Data Fabric and Active Zero Trust (2024–Present):

Leading the technical and strategic development of a framework to support a Prevent-Protect-Mitigate-Respond-Recover (P2MR2) physical security team stationed at an overseas allied partner nation installation, amidst strategic rivalry between great powers. This P2MR2 framework is designed for reporting:

1. Operations Research and Analytical Modeling
 2. Threat Assessment and Capability Scoring (risk, resilience, interoperability breakdowns)
 3. Annual Prioritization Efforts & Planning/Briefing Support
- Developed a **hierarchical architecture and ontology to unify physical, cyber, and cognitive layers** within a single mission framework using **Multi-Domain Decomposition & Workflow Modeling**.
 - Designed a **memory schema for agentic AI modules to leverage dynamic conversation-driven access**, preventing adversarial probing and data leakage using **Agentic AI Pipeline & Active Zero-Trust Security**.
 - Applied concepts from operations research to model P2MR2 protocols to measure how well different cross-domain mission components can support one another in crises, ensuring multiple pathways exist to accomplish critical tasks using **Mathematical Interoperability & Resilience**

NATO: Military Mobility Innovation Challenge Internal R&D (2023-Present):

Led a team of multi-domain subject matter experts, model-based engineers, and AI/data scientists, to modify the ELLISON framework (2022) for Encapsulation and Integration; developing designs to encapsulate domain behaviors and create a digital twin (DT) of those behaviors within a simulation environment.

- Designed **Modular Composable Microservices** to analyze system components and processes to abstract physical and functional layers of military and mobility networks.
- Designed **All-Domain Data Fusion** to link an array of inputs from civil, military, and commercial sources, including distributed and human-in-the-loop sensors, that serve as synchronization mechanisms to update the intelligence data for the network DT.
- Designed an **Extensible Ontology** framework around analysis standards to enable interoperability and data exchange between DTs across different platforms and use cases.

ELLISON: An Integrated Solution to Entity Management for OSINT Analysis (2022-Present)

Collaborated with a team of intelligence and OSINT analysts to design and implement a new semantic search methodology that enhances intelligence analysis, curating data and evidence through a tiered AI-Driven Entity Management framework, that works in parallel with the human in the loop intelligence analyst, to make intelligence analysis more effective by gathering and connecting relevant data to build a structured and interconnected system of evidence.

- Applied graph theory and knowledge representation techniques to model typed dependencies within the **Ontology Design**.
- Applied information theory and natural language processing to calculate statistics that capture semantic associations within **Distributional Semantics**.
- Applied graph embeddings and network analysis to encode information within and between event chains for **Narrative Relation Learning**.
- Applied data analysis and geometric techniques to embed ontologies for clustering and visualization using **Similarity Metrics Integration**.

AFIMSC: AI/MLOps Ecosystem Framework for Automated Condition Assessment (2021-2022)

Mr. Carrola led a team of data scientists and software engineers, to develop an AI-powered visual assessment ecosystem that extracts features from AEC infrastructure imagery, quantifies condition scores, and integrates explainable metadata

into Air Force AEC management systems for transparent assessments. Key innovations included perceptual models for analyzing structural AEC components and a modular MLOps pipeline orchestrating data collection, image processing, and machine learning for accurate facility inspections.

- **Image Acquisition and Preprocessing:** Applied signal processing techniques such as filtering, normalization, and noise reduction to prepare images for analysis. Developed transformation and manipulation algorithms to represent the image data as matrices or multidimensional structures.
- **Feature Extraction and Region of Interest Analysis:** Customized computer vision algorithms for identifying and delineating specific features within images (e.g., edges, corners, regions). Developed custom geometric and image processing descriptors to calculate shape properties and material descriptors.
- **Development of Condition Assessment Models:** Applied statistical learning models to infer condition scores from architectural image features. Implemented multivariate classification techniques for severity classification of architectural features based on patterns of custom AEC descriptors.
- **Data Structuring and AI Model Integration:** Modeled relationships in the data to structure the output data to fit into the BUILDER Sustainment Management System.
- **AI/MLOps for Model Management and Deployment:** Researched and developed process and operation models to model performance and quantify uncertainty, to implement an MLOps pipeline for efficient model training and deployment.

NATO: Cognitive Warfare Concept Community of Interest Facilitator and Researcher (2021)

Developed and presented a data-driven framework to study cognitive biases, functional impacts, and threat scenarios related to cognitive warfare across the ecosystem of social networks and platforms to NATO's Concept Development Team. Analytical models were created to evaluate capabilities, map ecosystems, and provide recommendations.

- Developed framework models to **represent biases and impacts on cognition** using **Cognitive Bias Modeling**.
- Utilized knowledge graphs and hierarchies to map relationships between entities and ideas using **Network Analysis**.
- Applied scenario analysis to explore combinations of biases and project possible outcomes on decisions and cognitive capabilities within a novel **cognitive threat ecosystem model**.
- Mapped knowledge graphs into different representation spaces to measure system dynamics, dependencies and visualize relationships using **Ecosystem Mapping**.

SwRI Internal Research and Development (IR&D): Machine Learning Techniques for Intelligence Asset Reconstruction and Analysis (2019-2021)

Engaged in both research proposal and program work to develop techniques (deep learning; adversarial) for supporting Intelligence operations in recovering and reconstructing specified features in captured low-resolution and low-quality image data for evidence analysis.

- Categorized the reconstructed image features
- Measured accuracy and uncertainty for the generated images

UTSA Research: An Open-Source Intelligence Approach to Understand Cognitive Bias among Groups (2019)

Researched cultural groups and compared their cognitive biases toward events and social themes (e.g., 'healthcare'; 'climate change'). The approach measured biases within culturally derived social media texts to support ethnographic research using machine learning techniques; turning "Big" data into "Thick" (ethnographic) data.

- **Cross-referenced the cognitive biases** of groups measured in targeted datasets against relevant open-source demographic and empirical data, then approximated the diversity of cultural attitudes for context to the group's observed cultural behavior.
- Validated detected biases and **characterized them against relevant social trends**.
- Project showed cognitive biases in cultural language models can characterize social trends, to **support**

sociological analysis through big data.

SwRI IR&D: Shape Memory Alloys for Aerospace and Space Applications—Forecasting Technological Gaps in Nitinol-based Shape Alloy Research from Metadata and Language in Scientific Publications (2017-2018)

Developed and programmed a systematic approach using machine learning techniques to analyze the text and metadata of scientific articles for identifying risk indicators, before adopting emerging technologies into production.

- Utilized an abstraction and categorization methodology to **identify a dataset's essential elements of interests**.
- The technical gaps identified in candidate technologies, **prompted design teams to optimize designs** and work within the constraints of the identified technical challenges.

SwRI DT IR&D: Novel Power Generation from Bacteria (2017)

Proposed and developed a concept inspired by the DARPA Vanishing Programmable Resources (VAPR) program with the goal of bio-electronics with the goal of physically disappearing when needed; brought together mechanical engineers and microbiologists to test a new method of exploiting bacterial behavior to generate power.

- Collaborated on developing the predictive model for power generation from the bacteria, and **extending previous models^{3,4,5} for measuring the biophysical behavior** of the swimming bacteria and its effect on the system and power output
- **Conceptually developed and managed** the project

SwRI IR&D: Enhanced Attribution of Cyber Attacks Through Cognitive Tagging and Attack Signature Analysis (2016)

Developed a method to improve cyber-attack attribution by analyzing attack signatures across the attack lifecycle and applying cognitive-based tagging to link persona information with cyber actions.

- Prototyped a system to extract **Initial Recon signatures** from human interactions in both BLUE and RED environments, using activity abstraction tools.
- Extended cognitive fingerprinting method to implicitly **track and identify human attackers**, enabling hidden tagging of activities for persona tracking.
- Executed experiments to **distinguish automated from manual attacks** in BLUE space by analyzing attack signatures and identifying tools and attacker skill levels.

SwRI IR&D: Fingerprinting Digital Manipulations for Visual Media Forensic Applications (2016)

Proposed, developed, and programmed experimental visual media forensics software to automatically detect image manipulations and provide information about the manipulation techniques performed.

- Developed a methodology to **fingerprint image editing tools at the pixel-level** when they alter an image
- Focused on building a taxonomy of basic image editing tools, to **attribute a variety of forgery methods**.

RDECOM: Passive Computer Vision Tracking Methodologies for Multi-Touch Soft Tissue Interfaces and Simulations (2013-2015)

Devised an **innovative method** using computer vision and machine learning algorithms to **passively track synthetic tissue** for real-time, augmented reality medical training simulations.

This invention (Patent US 9,218,660 B2)² was reported at the 2013 NextMed/MMVR, Medicine Meets Virtual Reality conference.

- Designed experiments and test matrices to **develop synthetic skin with stiffness comparable to human epidermis**.
- Analyzed the effects of additives to the material, quantifying agents with significant effects to **achieve comparable stiffness to human skin**.

DARPA: Active Authentication Using Covert Games in Mobile Applications (2013-2014)

Led the development of a **cognitive-based authentication biometric for Android mobile devices**, utilizing covert games for active authentication.

- Devised the **experimental strategy** to analyze interactive UI elements and developed a game-theoretic framework for programmatic user authentication.
- Employed principal component regression techniques to **design and test covert, game-like interactions** that accurately discriminated users.
- Evaluated the concept using **hypothesis testing and ROC analysis**

DARPA: Active Authentication Using Covert Cognitive Interrogation Games (2011-2013)

Developed a novel cognitive-based authentication biometric for DARPA's Active Authentication program. **Led software development** and the creation of a predictive model based on experimentally observed cognition patterns.

- Used cross-discriminability analysis and regression techniques to **evaluate the robustness and uniqueness** of the cognitive-based authentication signature.
- Tested and validated the system by establishing **statistical significance** and defining sampling methodologies in human participant experiments

John Deere, AT&T, U.S. Air Force: Modeling, Training and Simulation Programs (2003-2015)

Mr. Carrola's expertise and creativity using various polygonal modelers, mathematics, and graphic design tools supported several real-time training and simulation projects.

- Developed real-time 3D animations and data visualizations using various 3D technologies (Autodesk 3D Max, Cinema4D, Unity3D)
- Supported increasing visual realism in the simulations through shader and render engine development (GPU programming; Cg; OpenGL), and processing polygonal structures for UV mapping / unwrapping and complex texturing
- Experience applying various programming environments, languages and scripting (JavaScript, C#, Java, Python) towards designing interactive components and GUIs for software and real-time applications

PUBLICATIONS & PATENTS

1. **Carrola, J.**, Guillory S., Borsky G. (2023). Through a Quantum Lens: Beyond Borders and into the Complex Forces Shaping Social Reality of the Balkans and Eurasia". Europe-Eurasia Experts Network (E3N) Strategic Concepts Journal (*Booz Allen Hamilton Internal*)
2. *"What Online-Offline (O-O) Convergence Means for the Future of Conflict"*. (2022) **John T. Carrola** (Co-author); Sean A. Guillory
 - a. <https://information-professionals.org/what-online-offline-convergence-means-for-the-future-of-conflict/>
3. Wheeler, J., Varner, D., **Carrola, J.**, Dahlberg, C., Thornton, T., Bohil, C., Terry, K. (2013). Covert cognitive games and user response patterns. *IT Professional* volume 15, issue 4, year 2013, pp. 16 – 19
4. **Carrola, John T.**, et al. "Machine vision systems and methods for analysis and tracking of strain in deformable materials." U.S. Patent No. 9,218,660. 22 Dec. 2015.
5. Bařaęaoęlu H, S Allwein, S Succi, H Dixon, **JT Carrola Jr**, S Stothoff (2013). Two- and three dimensional lattice-Boltzmann simulations of particle migration in microchannels. *Microfluidics and Nanofluidics*, 15(6):785-796.
6. Bařaęaoęlu H, **Carrola JT**, Freitas CJ, Bařaęaoęlu B, Succi S, 2014. Lattice Boltzmann simulations of vortex entrapment of particles in a microchannel with curved and flat edges. *Microfluidics and Nanofluidics*, DOI 10.1007/s10404-014-1509-5
7. Bařaęaoęlu H, **Carrola JT**, Freitas CJ, Bařaęaoęlu B, and DeSilva M, 2014. Numerical analysis of vortex entrapment of particles with respect to bacterial adhesion on implants. Presentation. Biomedical Engineering Society's Annual Meeting, San Antonio, TX, October 22-25, 2014