

Zoe N. Gastelum (née Meyer)
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Professional Appointments

Sandia National Laboratories, Albuquerque, NM, USA

R&D Systems Analyst, February 2015 – Present (Principal Member 01/2018 – Present; Senior Member 02/2015 – 12/2017)

International Safeguards & Engagements Department

International nuclear safeguards systems analyst responsible for research and development of analytical tools and methods to support international nuclear safeguards and nonproliferation verification, and their interaction with human users. Principle Investigator coordinating multiple research teams each of 2-5 early and mid-career technical staff, for over \$1.3M of grant funding per year. Program lead responsible for direct interactions with multiple U.S. Department of Energy sponsors for international nuclear safeguards research and development portfolios, responsible for safeguards research & development programs exceeding \$2M annually.

R&D Manager (Acting), February 2021 – June 2021

International Safeguards & Engagements Department

Interim department manager for nine technical staff members and four students, appointed by the Senior Manager. Responsibilities included program management for three international safeguards and export control offices within the U.S. Department of Energy which constituted over \$7 Million in funding at Sandia, including the management of five distinct proposal call cycles during my acting tenure. Line management accomplishments included mid-year performance reviews, monitoring staff and project impacts of the ongoing COVID-19 pandemic, supporting the staff promotion process, hiring two new staff members, managerial approval for all staff publications from my department and programs, and supporting division-level strategic planning.

Pacific Northwest National Laboratory, Richland, WA, USA

Safeguards Research Scientist (Scientist & Engineer 2 – 3), November 2011 – January 2015

Fundamental & Computational Science Directorate and National Security Directorate

Safeguards Policy Analyst (Specialist 2), May 2008 - October 2009

National Security Directorate

Nuclear nonproliferation research scientist responsible for managing and contributing to projects related to information analysis technologies and computational models in support of the international safeguards, export controls, and arms control and disarmament missions of the US Department of Energy (DOE).

International Atomic Energy Agency, Vienna, Austria

Open-Source Information Analyst (Junior Professional Officer, P2), October 2009 - October 2011

Department of Safeguards

Analyst responsible for open-source information collection and analysis supporting safeguards verification activities in 20+ countries per year, and production of a daily safeguards briefing distributed to over 500 IAEA staff members.

Education

Georgia Institute of Technology, Atlanta, GA, USA

PhD student in School of Public Policy, Major in Science & Technology Policy with Minor in International Affairs. Expected Fall 2026.

Dissertation Research Area: AI Policy for International Nuclear Safeguards

Universite Montpellier 1, Montpellier, France

Diplôme (graduate certificate) in International Nuclear Law. April 2013

Thesis: *International Legal Framework for Denuclearization and Nuclear Disarmament – Present Situation and Prospects*

The University of Texas, Austin, TX, USA

Master of Arts in Latin American Studies, Major in International Security. December 2007

Thesis: *Regional Cooperation on Nuclear Safeguards: An Evaluation of Existing and Proposed Regional Safeguards Regimes and a Proposal for Increased Cooperation in South America*

The University of New Mexico, Albuquerque, NM, USA

Bachelor of Arts in Political Science, Minor in Sociology. May 2006

Graduated with Honors in International Studies. Summa Cum Laude.

Peer Reviewed Journal Articles

*Matzen, L.E., Stites, M.C., **Gastelum, Z.N.** (2021) “Studying visual search without an eye tracker: an assessment of artificial foveation.” *Cognitive Research: Principles and Implications* 2021 6:45, pp. 1 - 22.

<https://doi.org/10.1186/s41235-021-00304-2>

Gastelum, Z.N., Mattes, A., Matzen, L.E., Stites, M.C. (2020) “Cognition-Informed Safeguards: Lessons and Recommendations for Safeguards Practitioners from Cognitive Science Research.” *ESARDA Bulletin: The International Journal of Nuclear Safeguards and Non-Proliferation*, No. 61. December, pp. 39 - 53.

*Stites, M. C., Matzen, L. E., **Gastelum, Z.N.** (2020) “Where are we going and where have we been? Examining the effects of maps on spatial learning in an indoor guided navigation task.” *Cognitive Research: Principles and Implications*, 5:13, pp. 1 - 26. <https://doi.org/10.1186/s41235-020-00213-w>

Gastelum, Z.N. and Shead, T.M. (2018) “Inferring the Operational Status of Nuclear Facilities with Convolutional Neural Networks to Support International Safeguards Verification.” *Journal of Nuclear Materials Management*, Vol. 46 No. 3. November 2018, pp. 37 – 47.

Gastelum, Z.N., Smartt, H.A., Horak, K.E., Moyer, E.M., St. Pierre, M.E. (2017) “Brain Science and International Nuclear Safeguards: Implications from Cognitive Science and Human Factors Research on the Provision and Use of Safeguards-Relevant Information in the Field.” *ESARDA Bulletin: The International Journal of Nuclear Safeguards and Non-Proliferation*, No. 54. June 2017, pp. 62 – 69.

Invited Book Chapter

Gastelum, Z.N. “Societal Verification for Nuclear Nonproliferation and Arms Control.” *Nuclear Non-proliferation and Arms Control Verification: Innovative Systems Concepts*. Eds., Mona Dreicer, Irmgard Niemeyer, Gotthard Stein. Springer, December 2020.

Refereed Conference Proceedings

Gastelum, Z.N., Divis, K., Dorawa, S., Coram, J., Howell, B., “Building Trust in Safeguards Voice User Interfaces: An Experimental Approach.” Proceedings of the Joint Annual Institute of Nuclear Materials Management and European Safeguards Research & Development Association Annual Meeting, May 2023.

Gastelum, Z.N., Matzen, L.E., Divis, K.M., Howell, B., “Cognitive Impacts of Computer Vision-Based Decision Support for International Nuclear Safeguards-Relevant Visual Analysis Tasks.” IAEA Symposium on International Safeguards: Reflecting on the Past and Anticipating the Future, November 2022.

Gastelum, Z.N., Shead, T.M., Marshall, M.R., “But it Looks so Real! Challenges in Training Models with Synthetic Data for International Safeguards.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2022.

*Divis, K., Howell, B., Matzen, L., Stites, M., **Gastelum, Z.**, “The Cognitive Effects of Machine Learning Aid in Domain-Specific and Domain-General Tasks.” Proceedings of the Hawaii International Conference on System Sciences, January 2022.

*Matzen, L.E., Stites, M.C., Howell, B.C., **Gastelum, Z.N.**, “Different Visualizations of Machine Learning Outputs Influence the Speed and Accuracy of User Evaluations.” Proceedings of the VisXVision Workshop at the IEEE VIS Conference, October 2021.

Gastelum, Z.N., Shead, T.M., Rushdi, A. “A Large Safeguards-Informed Hybrid Imagery Dataset for Computer Vision Research and Development.” Proceedings of the Joint Institute of Nuclear Materials Management / European Safeguards Research and Development Association Annual Meeting, August 2021.

Gastelum, Z.N., Matzen, L.E.; Stites, M.C.; Howell, B.C. “Not all Errors are Created Equal: Examining Human-Algorithm System Performance for International Safeguards-Informed Visual Search Tasks.” Proceedings of the Joint Institute of Nuclear Materials Management / European Safeguards Research and Development Association Annual Meeting, August 2021.

Smartt, H.A., **Gastelum, Z.N.**, Rutkowski, J.E., Peter-Stein, N. “Hey Inspecta!” Proceedings of the Joint Institute of Nuclear Materials Management / European Safeguards Research and Development Association Annual Meeting, August 2021.

*Jones, A.P., Trumbo, M.C., Matzen, L.E., Stites, M.C., Howell, B.C., Divis, K.M., **Gastelum, Z.N.**, “Evaluating the Impact of Algorithm Confidence Ratings on Human Decision Making in Visual Search.” Proceedings of Human Computer Interaction International, July 2021.

Gastelum, Z.N., Shead, T., Higgins, M. “Synthetic Training Images for Real-World Object Detection.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2020.

Gastelum, Z.N., Matzen, L.E., Stites, M.C., Jones, A., Trumbo, M., Howell, B.C., Higgins, M. “Evaluating the Cognitive Impacts of Errors from Analytical Tools in the International Nuclear Safeguards Domain.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2020.

Higgins, M., **Gastelum, Z.N.**, “Industry’s Use of Deep Learning and Implications for International Safeguards.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2020.

Dunlavy, D.M., Bisila, J., **Gastelum, Z.**, Ulmer, C. “Topic Modeling with Natural Language Processing for

Identification of Nuclear Proliferation-Relevant Scientific and Technical Publications.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2020.

*Matzen, L., Stites, M.C., Smartt, H.A., **Gastelum, Z.N.**, “The Impact of Information Presentation on Visual Inspection Performance in the International Nuclear Safeguards Domain.” Proceedings of Human Computer Interaction International, July 2019.

*Stites, M.C., Matzen, L., Smartt, H., **Gastelum, Z.**, “Effects of Note-Taking Method on Knowledge Transfer in Inspection Tasks. Proceedings of Human Computer Interaction International, July 2019.

Gastelum, Z.N., Horowitz, S.M., Swanson, M.C., “Considerations for the Development and Implementation of Crowdsourcing to Support International Nuclear Safeguards Verification Activities.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2019.

Gastelum, Z.N., Matzen, L.E., Stites, M.C., Smartt, H.A., “Human Performance Testing on Observation Capture for International Safeguards Inspections: Transferring Knowledge from the Field to Headquarters and Back.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2019.

Gastelum, Z.N., Luttman, A., Goldblum, B.L., Shead, T.M., Stewart, C., “Integrating Physical and Informational Sensing to Support Nonproliferation Assessments of Nuclear-Related Facilities.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2019.

Gastelum, Z., Feldman, Y. “The International Safeguards Working Group on Open Source and Geospatial Information: Overview, Activities, and Future Plans.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2019.

Disser, J.J., Bachner, K., Pepper, S., **Gastelum, Z.N.**, “Communicating what INMM does: The INMM Communicator Challenges and Successes.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2019.

Gastelum, Z.N., Stites, M.C., Matzen, L., “The Role of Maps in Site Knowledge and Wayfinding: A Human Performance Evaluation for International Nuclear Safeguards Inspections.” Proceedings of the 41st European Safeguards Research and Development Association Annual Meeting Symposium on Safeguards and Nuclear Material Management, May 2019.

Gastelum, Z.N., Matzen, L.E., Smartt, H.A., Stites, M.C., “Human Performance Testing for Cognitive Science-Informed Informational Provision for International Nuclear Safeguards Inspectors.” Proceedings of the IAEA Safeguards Symposium, November 2018.

Gastelum, Z.N., Hinderstein, C., Crawford, C.E., Pickett, C.A., Disser, J.J., Swanson, M.C., Bachner, K.M., Frazar, S.L., Horak, K.E., Klein, E., Horowitz, S.M., “The Role of Professional Societies in Effective Communications for International Safeguards: How the Institute of Nuclear Materials Management Supports Existing and Emerging Nuclear Materials Stewardship Communities.” Proceedings of the IAEA Safeguards Symposium, November 2018.

Cui, Y., **Gastelum, Z.N.**, Ren, R., Smith, M.R., Lin, Y., Thomas, M.A., Yoo, S., Stern, W., “Using Deep Machine Learning to Conduct Object-Based Identification and Motion Detection on Safeguards Video Surveillance.” Proceedings of the IAEA Safeguards Symposium, November 2018.

Feldman, Y., **Gastelum, Z.**, Reed, J., Dupuy, G., “Integrating Visual Data into Safeguards Implementation and the State Evaluation Process.” Proceedings of the IAEA Safeguards Symposium, November 2018.

Thomas, M.A., **Gastelum, Z.N.**, Shead, T.M., “Semantic Graphs for Safeguards Data Integration, Pattern Matching, and Event Classification.” Proceedings of the IAEA Safeguards Symposium, November 2018.

Gastelum, Z.N., Matzen, L.E., Stites, M.C., Smartt, H.A., “Cognitive Science Evaluation of Safeguards Inspector List Comparison Activities using Human Performance Testing.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2018.

Horowitz, S.M. **Gastelum, Z.N.**, Smartt, H.A., Solodov, A., DeLand, S., Wallace, E., Koskelo, M., Swanson, M., Hernandez, T., “INMM Novel Technologies Workshop Encourages Safeguards and Arms Control Researchers to Think Beyond Traditional Verification Measures. Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2018.

Gastelum, Z.N., Smartt, H.A., Matzen, L., Horak, K., Solodov, A.A., Moyer, E.M., St. Pierre, M.E., “Testing Human Performance in Simulated In-Field Safeguards Information Environments.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2017.

Gastelum, Z.N., Shead, T.M., “Preliminary Applications of Neural Networks to Support Assessment of Ground-Based Imagery for International Safeguards Analysis.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2017.

Gastelum, Z.N., Sentz, K., Rinaudo, C., Swanson, M.C., “Power of the People: Crowdsourcing Design to Support International Nuclear Safeguards Verification Activities.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2017.

Gastelum, Z.N., Feldman, Y., Niemeyer, I., Horak, K., “Evolution of and Path Forward for Information Technologies to Support Open Source and Geospatial Information Analysis of Nonproliferation Verification Activities.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2017.

Disser, J., **Gastelum, Z.N.**, Reed, J., Bolden, L., Smart, J.E., “Unmanned Aerial Systems Applications for International Nuclear Safeguards.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2017.

Dupuy, G., Feldman, Y., Reed, J., **Gastelum, Z.N.**, “Enhancing the Use of Multimedia Information for IAEA Safeguards Analysis.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2017.

Gastelum, Z.N., Matzen, L.E., Moyer, E.M., St. Pierre, M.E., “Brain Science and International Nuclear Safeguards: Implications from Cognitive Science and Human Factors Research on the Provision and Use of Safeguards-Relevant Information in the Field.” Proceedings of the 39th ESARDA symposium on Safeguards and Nuclear Non-Proliferation, May 2017.

Kornell, J., **Gastelum, Z.N.**, Goldblum, B., “Informational Sensing for Nonproliferation.” Proceedings of the American Nuclear Society Advances in Nuclear Nonproliferation Technology & Policy Conference, September 2016.

Gastelum, Z.N., Thomas, M.A., Shead, T.M., “Semantic Graphs for Pattern Detection in Sensor Data from Monitoring Regimes.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2016.

Gastelum, Z.N., Brotz, Jay, K., Le, T.D., Whalen, R.T., Bolles, J.C. "Proposed Use Cases for Augmented Reality for Nuclear Nonproliferation Verification and Training." Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2016.

Gastelum, Z.N., Gitau, E.T., Doehle, J.R., Erickson, A.R., "An Impact Assessment of Advanced Information Technologies for IAEA Safeguards Inspections." Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2016.

Thomas, M.A., **Gastelum, Z.N.**, Kubica, S., "Advanced Analytics for International Safeguards." Proceedings of the Eighth Joint INMM/ESARDA Workshop: Building International Capacity, October 2015.

Gastelum, Z.N., Henry, M.J., Burtner, E.R., Doehle, J.R., Zarzhitsky, D.V., Hampson, S.D., LaMothe, R.L., Nordquist, P.L., "The Development of an Example Precision Information Environment for International Safeguards Use Cases." Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2015.

Smartt, H.A., **Gastelum, Z.N.**, "Tamper-Indicating Enclosures, A Current Survey." Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2015.

Gastelum, Z.N., Doehle, J.R., Gitau, E.T., "Computer Security in an Increasingly Mobile World." Proceedings of the International Conference on Computer Security in a Nuclear World: Expert Discussion and Exchange, June 2015.

Whattam, K.M., **Gastelum, Z.N.**, Cramer, N.O., Conklin, K., "Hackers and Proliferators: Examining the Nonproliferation and Cyber Security Nexus." Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2014.

White, A.M., **Gastelum, Z.N.**, Whitney, P.D., "Developing a Validation Methodology for Expert-Informed Bayesian Network Models Supporting Nuclear Nonproliferation Analysis." Proceedings of the Information Analysis Technologies, Techniques and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, May 2014.

Whattam, K.M., Godwin, S., **Gastelum, Z.N.**, Craig, P.A. Jr., Landine, G.P., Conklin, K. "A Threat Assessment Methodology for Critical Digital Assets of Nonproliferation Agencies: Preliminary Results." Proceedings of the Information Analysis Technologies, Techniques and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, May 2014.

Webster, J.B. Erikson, L.E., **Gastelum, Z.N.**, Lewis, V.A., Hogan, E.A., Best, D.M., Chikkagoudar, S., "Signatures of Illicit Nuclear Procurement Networks: An Overview of Preliminary Approaches and Results." Proceedings of the Information Analysis Technologies, Techniques and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, May 2014.

Gastelum, Z.N., Henry, M.J., LaMothe, R.R., Barr, J.L., Burtner, E.R., Smith, L.E., "A Safeguards Information Environment for Inspectors Possibilities and Proof-of-Concept." Proceedings of the Scanning the Horizon: Novel Techniques and Methods for Safeguards Workshop, January 2014.

Gastelum, Z.N., White, A.M., Whitney, P.D. Gosink, L.J., Sego, L.H. "The Lifecycle of Bayesian Network Models Developed for Multi-Source Signature Assessment of Nuclear Programs." Proceedings of IEEE International Conference on Intelligence and Security Informatics (ISI 2013), Seattle, Washington, June 2013, ed. K Glass, et al,

pp. 339-345. IEEE, Piscataway, NJ. doi:10.1109/ISI.2013.6578855

Gastelum, Z.N., Cramer, N.O., Benz, J.M., Kreylin, S.J., Henry, M.J., Whattam, K.M., Corley, C.D., “Identifying, Visualizing, and Fusing Social Media Data to Support Nonproliferation and Arms Control Treaty Verification: Preliminary Results.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2013.

Gastelum, Z.N., Whitney, P.D., White, A.M., “Bayesian Model Development for Analysis of Open Source Information to Support the Assessment of Nuclear Programs.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2013.

Kreyling, S., Williams, L., **Gastelum, Z.**, Whattam, K., Corley, C., Cramer, N., Gregory, M., “Use of Social Media to Target Information-Driven Arms Control and Nonproliferation Verification.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2012.

Cojazzi, G.G.M., van Der Goot, E., Wolfart, E., **Gastelum, Z.**, Hammond, W., Feldman, Y., Zarucki, R., Ferguson, M. “Collection, Analysis, and Dissemination of Open Source Safeguards-Relevant News Using Web Based Applications.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2011.

Coles, G., **Gastelum, Z.**, “Challenges in Implementing Methodologies for Nonproliferation Assessments.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2011.

Gastelum, Z., Olson, J., Zenter, M.D., “Training the Next Generation: Proliferation Pathway Red Team Exercises Reinforce Key Safeguards Concepts.” Proceedings of the INMM Central Chapter 2009 Fall Meeting, September 2009.

Short, S., Weimar, M., Kreyling, S., **Gastelum, Z.**, Phillips, J., Wood, T., “Nuclear Fuel Leasing – An Assessment of Economic and Nonproliferation Benefits.” Proceedings of Global 2009, September 2009.

Gastelum, Z., Zentner, M.D., “Challenges in the Preliminary Results Display from the GIF Proliferation Resistance and Physical Protection Evaluation Methodology.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2009.

Frazar, S., **Gastelum, Z.**, Olson, J., Mathews, C., Solodov, A., Zhernosek, A., Raffo-Caiado, A.C., Baldwin, G., Horak, K., McClelland-Kerr, J., VanSickle, M., Mininni, M., Kovacic, D., “Technical Training Workshop on International Safeguards: An Introduction to Safeguards for Emerging Nuclear States.” Proceedings of the Institute of Nuclear Materials Management Annual Meeting, July 2009.

Coles, G., **Gastelum, Z.**, Brothers, A., Thompson, S., “Utility of Social Modeling for Proliferation Assessment – Preliminary Findings.” Proceedings of the 50th Annual Meeting of the Institute for Nuclear Materials Management, July 2009.

Meyer, Z., Raffo-Caiado, A.C., Ehinger, M., Kovacic, D., “The Global Nuclear Energy Partnership and Compliance with the Nuclear Nonproliferation Regime.” Proceedings of the Institute for Nuclear Materials Management, July 2007.

Rexroth, P.E., Saltiel, D.H., Rochau, G.E., Mendez, C.M., Ng, S., Greneche, D., **Meyer, Z.**, Giannangeli, D., Charlton, W.S., “Strengthening the Foundation of Proliferation Risk Assessment Methodologies.” Proceedings of the 47th Annual Meeting of the Institute for Nuclear Materials Management, July 2006.

Journal Issue Editor

ESARDA Bulletin: The International Journal on Nuclear Safeguards and Non-Proliferation

Guest editor, special issue on Data Analytics for Nuclear Safeguards and Non-Proliferation N. 63, (in press) December 2021.

Statistical Analysis and Data Mining

Associate Editor, CoDA 2019 special issue (14:6), December 2021. <https://doi.org/10.1002/sam.11470>

Journal of Nuclear Materials Management

Co-Editor, special issue on Open Source and Geospatial Information Analysis, Volume XLVI, No. 3, November 2018.

Posters

(forthcoming, accepted) **Gastelum, Z.N.**, “Non-Safeguards AI to Support the International Nuclear Safeguards Verification Mission: A Proposal for Capability Optimization.” Gordon Research Conference on Nonproliferation, Counterproliferation and Disarmament Science, July 2023.

Gastelum, Z.N., Shead, T., Marshall, M., “Using Object Detection to Train Better Image Classifiers: Unexpected Findings from Validation of a Large, Synthetic International Nuclear Safeguards Dataset.” Conference on Data Analysis (CoDA), March 2023.

Gastelum, Z.N., Howell, B.C., Divis, K., Matzen, L.E., “When in Doubt, Trust AU? User Performance and Task Difficulty in a Safeguards-Relevant Visual Identification Activity.” International Atomic Energy Agency Technical Meeting on Artificial Intelligence for Nuclear Technology and Applications (AI4Atoms), October 2021.

Gastelum, Z.N., Shead, T.M., Higgins, M., “The Use of Synthetic 3D Images to Drastically Reduce Real-World Training Data for Object Detection Models.” Conference on Data Analytics (CoDA), February 2020.

Gastelum, Z.N., Shead, T.M., “Predicting Nuclear Power Plant Operational Status Using Convolutional Neural Networks.” Conference on Data Analytics (CoDA), March 2018.

White, A.M., Whitney, P.D., **Gastelum, Z.N.**, Dalton, A.C., “Integrating Expert Judgment with Multi-INT Data to Model Human Behavior.” Signatures of Multi-Intelligence Workshop, September 2013.

Journal Notes

Gastelum, Z.N., Kreyling, S.J. Riley, T.R. (2015) “Outcomes of the Information Analysis Technologies, Techniques and Methods for Safeguards, Nonproliferation and Arms Control Workshop.” *Journal of Nuclear Materials Management*, Vol. XLIII, No. 3, pp. 30 – 35.

Selected Technical Presentations (2017 - Present)

Gastelum, Z., “Human Factors for International Nuclear Safeguards.” Human Factors Symposium, May 2023.

Gastelum, Z., “Trust Factors for Auditory User Interface for International Nuclear Safeguards Verification.” NSARD Program Review, April 2023.

Gastelum, Z., “Advanced Computer Vision Models for Synthetic Data.” NSARD Program Review, April 2023.

Gastelum, Z. Societal Verification, Machine Learning and Trust.” Societal Verification: Realizing Joseph Rotblat’s Vision in the Age of Non-state Open-Source Intelligence Workshop, Princeton University, April 2023.

Gastelum, Z., “Cognition-Informed International Safeguards.” Briefing to Australian Safeguards and Nonproliferation Office (ASNO) visit to SNL, March 2023.

Gastelum, Z., “Open Source Information Collection and Analysis R&D for International Safeguards.” Briefing to Australian Safeguards and Nonproliferation Office (ASNO) visit to SNL, March 2023.

Gastelum, Z., “Optimizing verification performance with human-computer teams.” European Safeguards Research and Development Association (ESARDA) Verification Technologies and Methodologies Working Group, January 2023.

Gastelum, Z.N. and Divis, K.M., “Trust Factors for Safeguards AUI Design.” Technical briefing for National Nuclear Security Administration sponsor visit to Sandia National Laboratories, January 2023.

Gastelum, Z.N., “Assessing Cognitive Impacts of Errors from Machine and Deep Learning.” Computational and Information Sciences External Review Board Meeting, June 2022.

Gastelum, Z.N., “Usability and AI Errors: Impacts for Nuclear Nonproliferation.” DOE Artificial Intelligence & Technology Office Visit to SNL-Livermore, June 2022.

Gastelum, Z.N., “Disruptive and Emerging Information Technologies for Safeguards & Non-Proliferation Verification.” Invited ESARDA Annual Meeting Plenary Address, May 2022.

Gastelum, Z.N., “Hybrid Imagery Data for International Safeguards Computer Vision R&D.” NSARD Program Review oral presentation, April 2022.

Gastelum, Z.N., “Synthetic Images for Deep Learning R&D supporting International Nuclear Safeguards.” Presentation for the Princeton Science & Global Security seminar series, April 2022.

Gastelum, Z.N., “Reflections on Working with Synthetic Imagery Data for International Safeguards.” Presentation at the ESARDA VTM/ INMM OSGI joint technical exchange on synthetic data, March 2022.

Gastelum, Z.N., Shead, T., “The Development of Real-World Validated Synthetic Imagery for Nuclear Nonproliferation Computer Vision Tasks.” University of Illinois Urbana-Champaign Program in Arms Control in Domestic and International Security, November 2021.

Gastelum, Z., “Artificial Intelligence & Nuclear Safeguards.” Cooperative Monitor Center Visiting Diplomat Technical Exchange, November 2021.

Gastelum, Z., Bisila, J., Cipiti, B., Hays, P., Linville, L., Shead, T., “Data Analytics, AI, and Virtual Reality for Defense Nuclear Nonproliferation.” National Academies of Sciences, Engineering, and Medicine Committee on the Review of Capabilities for Detection, Verification, and Monitoring of Nuclear Weapons and Fissile Material Visit, October 2021.

Gastelum, Z., Divis, K., Howell, B., Matzen, L., Stites, M., “User Performance Differences in Domain-General and Domain-Specific Interactions with ML.” Sandia Machine Learning and Deep Learning Workshop, July 2021.

Gastelum, Z., “Cognitive Sciences for International Nuclear Safeguards.” U.S. National Nuclear Security Administration Office of Global Material Security Innovative Analysis Team Lab Briefing, July 2021.

Wilson, B., and **Gastelum, Z.** (joint remarks), “Super Analysts: Data Science for International Safeguards.” Institute of Nuclear Materials Management Data Science Working Group Break with a Nuclear Data Scientist Speaker Series, February 2021.

Gastelum, Z., “Synthetic Imagery for Nuclear Nonproliferation.” Institute of Nuclear Materials Management Nonproliferation and Arms Control Technical Division Profiteroles and Proliferators Speaker Series, February 2021.

Gastelum, Z.N., “A Day in the Life of a Safeguards Information Analyst.” Cooperative Monitoring Center Speaker Series, February 2021.

Gastelum, Z.N., Stites, M.C., Matzen, L.E., Jones, A., Trumbo, M., Howell, B., “Cognitive Impacts of Errors from MLDL Models.” European Safeguards Research and Development Association’s Verification Technologies and Methodologies Working Group, December 2020.

Gastelum, Z.N., Stites, M., Matzen, L., Jones, A., Trumbo, M., Howell, B., “Examining the Cognitive Impacts of Errors from DL Systems for International Nuclear Safeguards Verification.” Nuclear Science and Security Consortium Virtual Learning Series, November 2020.

Gastelum, Z., “Crowdsourcing for Arms Control: Opportunities and Challenges.” 2020: Capturing Technology, Rethinking Arms Control Workshop (German Federal Foreign Office), November 2020.

Gastelum, Z.N., Matzen, L.E., Stites, M.C., Jones, A., Trumbo, M., “Deep Learning Models are Only as Good as Their Users, or: How Bad Models Can Be Good, and Better Models Can Be Worse.” Workshop on Next-Gen AI for Proliferation Detection: Accelerating the Development and Use of Explainability Methods Suitable for Nonproliferation Mission Applications, September 2020.

Gastelum, Z.N., Matzen, L.E., Stites, M.C., Jones, A., Trumbo, M., Howell, B., “How the Presentation of Results from MLDL Models Cognitively Impacts Users.” Sandia Machine Learning and Deep Learning Workshop, August 2020.

Gastelum, Z., “Cognitive Impacts of Errors in Human-Data Systems.” European Safeguards Research and Development Association’s Verification Technologies and Methodologies Working Group, December 2019.

Gastelum, Z.N., “Safeguards Inspectors Have Human Brains: Using Insights from Human Performance Studies for Inspection Planning.” 9th INMM/ESARDA/INMMJ Joint Workshop, Tokyo, October 2019.

Gastelum, Z.N., Matzen, L.E., Stites, M.C., Smartt, H.A., “Don’t Believe Your Eyes: Lessons from the Cognitive Science Community on Inattentive Blindness and their Relevance for International Safeguards Verification.” INMM Just Trust Me Workshop, Albuquerque, NM, March 2019

Gastelum, Z., “Overview of Tamper Indicating Device Use and Requirements.” University of Tennessee Institute for Nuclear Security’s 3S (Safety, Security and Safeguards) Course, December 2018.

Gastelum, Z., “Sandia National Laboratories Capabilities in Data Analytics.” Side Meeting with the International

Atomic Energy Agency Department of Safeguards Division of Information Management, November 2018.

Gastelum, Z., “The Human Component of Data Analytics for International Safeguards.” Invited Plenary, Institute of Nuclear Materials Management Central Region Chapter Workshop on Emerging Information Analysis Concepts for Nuclear Nonproliferation and Security, October 2018.

Gastelum, Z., Matzen, L., Smartt, Stites, M., “Cognitive Information Systems for International Nuclear Safeguards.” Office of International Nuclear Safeguards Program Visit to Sandia, April 2018.

Gastelum, Z., Matzen, L. “Cognitive Science Research for International Nuclear Safeguards.” National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control, Office of International Nuclear Safeguards Lunch and Learn, July 2018.

Gastelum, Z. “Using Deep Learning to Classify Open Source Imagery.” Presentation for International Atomic Energy Agency Department of Safeguards Division of Information Management Visit to Sandia, July 2018.

Gastelum, Z., Matzen, L., Moyer, E., Smartt, H., St. Pierre, M., Horak, K., “Cognitive Information Systems for International Nuclear Safeguards.” Defense Nuclear Nonproliferation Safeguards Program Visit to Sandia, August 2017.

Gastelum, Z.N., Solodov, A.A. “Unmanned Aerial Systems Applications for International Nuclear Safeguards.” INMM Novel Technologies, Techniques, and Methods for Safeguards and Arms Control Verification Workshop, August 2017.

Gastelum, Z., Matzen, L., Moyer, E., Smartt, H., St. Pierre, M., Horak, K., “Cognitive Information Systems for International Nuclear Safeguards.” Office of International Nuclear Safeguards Program Visit to Sandia, February 2017.

Research Grants

Successfully proposed research grants for 11+ years from the U.S. Government as a staff member in a Federally Funded Research and Development Corporation. Funding sources include the US Department of Energy’s National Nuclear Security Administration (NA-22 and NA-24) and Department of State (V-Fund), and internal research funds from Sandia’s Laboratory-Directed Research & Development (LDRD) program. Funded grants average over \$1 Million per year for the past five years.

Selected External Funding

- *Synthetic Computer Vision for Synthetic Data* (PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Research & Development. \$1 Million over 2 years, awarded October 2022
- *Cognition-Informed Safeguards Training* (PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control. \$200K for one year, awarded October 2022.
- *Trust in Auditory User Interface* (PI), National Nuclear Security Administration Defense Nuclear Nonproliferation Research & Development. \$1.3 Million over 3 years, awarded October 2021
- *Boots versus Bytes* (PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control.
 - \$365K for 1 year, awarded October 2022 (Gastelum transferred project to Adah Zhang after funding was awarded)
 - \$405K for 1 year, awarded October 2021.

- *Innovative Safeguards Working Group* (PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control.
 - \$275K over 1 year, awarded October 2022 (Gastelum transferred project to Bob Finch after funding was awarded)
- *Hybrid Imagery* (PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Research & Development. \$800K over 2 years, awarded October 2020.
- *Interdependent Networks* (co-PI) National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control. \$2.55 Million over 3 years, awarded October 2016.
- *Cognitive Informed Safeguards* (PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control. \$160K over 1 year, awarded October 2019. .
- *Multimedia Safeguards* (co-PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control.
 - \$15K for one year, awarded October 2021
 - \$70K for one year, awarded October 2020
 - \$60K for one year, awarded October 2019
 - \$60K for one year, awarded October 2018
 - \$30K for one year, awarded October 2017
 - \$50K for one year, awarded October 2016
- *Deep Deception* (PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control.
 - \$200K for 1 year, awarded October 2020 (Gastelum transferred project to David Farley after funding was awarded).
 - \$285K for 1 year, awarded October 2019.
- *Societal Mobilization* (co-PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control. \$255 K over 1 year, awarded October 2016.
- *Unmanned Aerial Systems Applications for International Nuclear Safeguards* (co-PI), National Nuclear Security Administration Defense Nuclear Nonproliferation, Nonproliferation and Arms Control. \$50.5K for 1 year, awarded October 2015.

Selected Internal Funding

- *Assessing Cognitive Impacts of Errors from Machine Learning and Deep Learning Models* (PI), Sandia Laboratory Directed Research & Development funding. \$830K over 2 years, awarded October 2019.
- *How Low Can you Go? Using Synthetic 3D Imagery to Drastically Reduce Real-World Training Data for Object Detection* (PI), Sandia Laboratory Directed Research & Development funding. \$350K for one year, awarded October 2019.
- *Cognitive Information Environments for International Safeguards Inspections* (PI), Sandia Laboratory Directed Research & Development funding. \$1.08 Million over 3 years, awarded October 2016.

Professional Society Memberships

Institute of Nuclear Materials Management (INMM)

- Senior Member, 2019 – present
- Professional Member, 2008 – 2019

European Safeguards Research & Development Association (ESARDA)

- Active Member since 2016 (via Sandia National Laboratories Associate Membership)

Professional Service

Conference on Data Analytics (CoDA)

- Organizing Committee Member, 2019 – present

European Safeguards Research and Development Association (ESARDA)

- Verification Technologies and Methodologies Working Group Chair, November 2020 – January 2023
- Verification Technologies and Methodologies Working Group Vice-Chair, 2018 – 2020
- Provided peer review for ESARDA Bulletin manuscript on data analytics, March 2023

Institute of Nuclear Materials Management (INMM)

- International Safeguards Technical Division Vice-Chair, 2020-present
- Open Source and Geospatial Information Analysis Co-Chair, 2016 - 2020
- Member at Large to the INMM Southwest Chapter, 2015 - 2017
- Communications Committee:
 - Chair, Communications Committee, 2017 – 2019
 - Vice-chair, Website Sub-Committee, 2016 – 2017
- Organizing Committee, Just Trust Me Workshop, 2019
- Organizing Committee, Novel Technologies, Techniques, and Methods for Safeguards and Arms Control Verification Workshop, 2017
- Workshop Chair, Information Analysis Technologies, Techniques and Methods for Safeguards, Nonproliferation and Arms Control Verification Workshop, 2014
<https://inmm.org/page/informationanalysis>

Women in Data Science (WiDS)

- WiDS Ambassador, 2020. Hosted the only New Mexico-based public viewing event for the annual Women in Data Science conference, including coordination of local speakers and career panel.

Miscellaneous

- Active participant in SPP Artificial Intelligence Policy Discussion Group
 - Presented on National Institute of Standards and Technology (NIST) AI Risk Framework, February 2023
 - Presented my own research-in-progress on bespoke AI models, April 2023

Awards

- Early Career Award, Institute of Nuclear Materials Management, 2019.
- National Security Directorate Exceptional Contribution Award, Pacific Northwest National Laboratory, 2014.