Alexander T. Graf, PhD

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Experience

11-16 to pres. General Electric Digital – Sr. Staff Data Scientist

- Unsupervised / Semi-supervised anomaly detection on multivariate time series for Army transport vehicles (DPGMM on moving window covariance).
- Health prediction for beef cattle (Ensemble classification)
- Root cause analysis for hypoxic US Navy F18 pilots (LDA topic modeling, partial dependence investigations, predictive model feature importance)
- Data validation and reconciliation (sensor failure detection)
- POC development with a high degree of customer engagement

02-16 to 11-16 General Electric Digital – Interim Manager of Data Science Services Team (~18 people)

- Lead the vision and strategy for group success.
- Manage expectations and guide careers of team members.

06-13 to 02-16 General Electric Digital – Staff Data Scientist

- Unsupervised anomaly detection on multivariate time series with feature importance for jet engines (Graphical Granger Causality)
- Semi-supervised learning applied to fault classification for jet engines
- Domain adaptation on continuous data for jet engines (MMDE and Tradaboost)
- Wavelet clustering on multivariate time series for fault identification
- Survival analysis (Random Survival Forest)
- Change point detection on multivariate time series (rank permutation)
- Bias correction and sampling methods for general application (resampling methods)
- Code and product development, internal white paper composition and various other lower level out-of-the-box analytics.

07-09 to 08-12 Lawrence Livermore National Laboratory (LLNL) – Postdoctoral Scientist (DoE Q cleared)

- X-ray probing of ultrafast processes in x-ray irradiated crystals
  - Project lead with responsibilities including diagnostic planning and construction, experimental execution, budget and people management (10 person team)
  - Data analysis included signal processing and multi-parameter regression on large data sets
- Photo-ionization and excitation measurements
  - Collaborator with responsibilities including planning and implementation of short pulse
    x-ray spectroscopic diagnostic
  - Data analysis required careful calibration, signal processing and noise suppression using time coincidence

12-05 to12-08 MIT Plasma Science and Fusion Center – Visiting Graduate Student / Research Assistant

- Plasma flow and temperature measurements in a tokamak
  - Project Lead with responsibilities including experiment organization, execution, diagnostic construction and budget management, coordination with larger 50+ person team.
  - Instrument control and time synchronized data acquisition / data base integration
  - Signal processing, multi-parameter regression, statistical significance testing
  - Monte Carlo modeling of neutral particle trajectories

12-02 to 12-05 LLNL – Visiting Graduate Student / Research Assistant

- X-ray spectroscopic measurements of astrophysical relevance

Education

12-08 **Ph.D. (Plasma Physics)** University of California at Davis (GPA 3.8)
12-05 to 12-08 Visiting Graduate Student at the MIT Plasma Science and Fusion Center
12-04 **M.Sc (Physics)** University of California at Davis
06-00 **B.Sc. (Physics)** University of North Florida

Technical interests

- NLP / Text Mining topics adapted to multivariate time series analysis (e.g. SAX and distributed word representations for unsupervised pre-training)
- Deep Learning topics for time series

Math and Computational Skills

Machine Learning, Probability and Statistics, Time Series Analysis, Calculus, Linear Algebra, Real and Complex Analysis, ODE/PDE, Numerical Analysis, Foundational Algorithms, Optimization

Python, R, Matlab, Git (Fluent) – AWS, Java, SQL, Spark, Javascript, D3, Bokeh (Functional)

Patents

- (Pending) Operator health proxy using adapted fatigue measures
- A Framework for Unsupervised Anomaly Detection on Industrial Time Series Data
- (Pending) Transfer Learning for Aviation Damage Models

Publications

A. Graf, "The Development of Benchmark Data Sets for Industrial Assets", Internal GE White Paper (2015)

A. Graf, "A Visible Spectral Survey in the Alcator C-Mod Tokamak", **Canadian Journal of Physics** 89:(5), p. 615 (2011)

A. Graf, "Measurement and Modeling of Na-like Fe XVI Inner-shell Satellites Between 14.5 Å and 18 Å", **Astrophysical Journal**, 695, 818 (2009)

A. Graf, "Multichannel Doppler Transmission Grating Spectrometer at the Alcator C-Mod Tokamak"**, Review of Scientific Instruments**, 79, 10F544 (2008)

A. Graf, "Spectroscopy on Magnetically Confined Plasmas using Electron Beam Ion Trap Spectrometers", **Canadian Journal of Physics** 86, 307 (2008)

A. Graf, "Lifetime of the 1s2p $^1P_1$ Excited Level in Fe^{24+}", Spectral Line Shapes: Volume 12, **16th ICSLS, AIP Conf. Proc.** CP645, edited by C. A. Back (American Institute of Physics, New York, 2002), p. 74-78

Co-Author Publications

W. Wierzchowski et al., Synchrotron topographic evaluation of strain around craters generated by irradiation with x-ray pulses from free electron lasers with different intensities, **Nuclear Instruments and Methods in Physics Research** Section B, 364, p.20-26 (2015)

A. Levy et al., "The creation of large-volume, gradient-free warm dense matter with an x-ray free-electron laser", **Physics of Plasmas**, 22 (3), 030703 (2015)

M. Hunter et al., "Fixed-target protein serial crystallography with an x-ray free-electron laser", **Scientific Reports (Nature) 4,** 6026 (2014)

D. Garvey et al., "Development of Next Generation Anomaly Detection & Isolation for GE90 Engines" **GE Report** GRC286 (2014)

M. Frank et al. "Femtosecond X-ray diffraction from two-dimensional protein crystals", **IUCrJ,** v.1, pt.2, 95 (2014)

C. Weninger et al., "Stimulated Electronic X-ray Raman Scattering", **Physical Review Letters**, 111, 233902 (2013)

J. Rudolph et al., “X-ray resonant photoexcitation: line widths and energies of K-alpha transitions in highly charged Fe ions”, **Physical Review Letters**, 111, 103002 (2013)

S. Bernitt et al., “Tackling the Astrophysical Fe XVII Emission Problem with a Free-Electron X-ray Laser”, **Nature** Dec. (2012)

S. Hau-Riege et al., “Ultrafast Disintegration of X-ray-Heated Solids”, **Physical Review Letters** 108, 217402 (2012)

N. Rohringer et al., “First Realization of an Atomic Inner-shell X-ray Laser at 1.46 nm Wavelength”, **Nature,** 481, 7382, p. 488 (2012)

J. Gaudin et al., "Amorphous to Crystalline Phase Transition in Carbon Induced by Intense Femtosecond X-ray Free-Electron Laser Pulses", **Physical Review B**, 86 024103 (2012)

J. Clementson et al., “Atomic data for the ITER Core Imaging X-ray Spectrometer”, **Proc. of the 39th European Physical Society Conference on Plasma Physics** (2012)

J. R. Crespo et al., “Photoionizing Trapped Highly Charged Ions with Sychrotron Radiation”, **Proc. for Atomic Processes in Plasmas** (2011)

J. Dunn et al., “Spectroscopic Studies of Hard X-ray Free-Electron Laser-heated foils at 10^{16} Wcm^{-2} Irradiances”, **SPIE Proc. X-ray Lasers and Coherent X-ray Sources** (2011)

K. Chu et al., “In-plane Rotation Classificiation for Coherent X-ray Imaging of Single Biomolecules”, **Optics Express**, 19, 12, 11691 (2011)

F. Graziani et al., “Large-scale Molecular Dynamics of Dense Plasmas: The Cimarron Project” (**High Energy Density Physics** June issue 2011)

S. Hau-Riege et al., “Interaction of Low-Z Inorganic Solids with Short X-ray Pulses at the LCLS Free-Electron Laser”, **Optics Express** 18, 23 p. 23933 (2010)

B. Labombard et al., “Critical Gradients and Plasma Flows in the Edge Plasma of Alcator C-Mod”, **Physics of Plasmas**, 15, 056106 (2008)

G. V. Brown et al., “Simulating Cometary and Stellar X-ray Emission in the Laboratory Using Microcalorimeters and an Electron Beam Ion Trap”, 14^{th} APS Atomic Processes in Plasmas, **AIP Conf. Proc. CP730**, edited by J. Cohen, S. Mazavet, and D. Kilcrease 730, 203 (2004)