The energy industry is being digitally transformed by investment at all levels of production, generation, transmission, and distribution: sensors, data analytics, new privacy-aware markets, and usage of smart meters in homes are all part of this transformation. However, the transformation of energy to be resilient to large environmental changes, faults (including maintenance errors), and cyber-attacks is still a work in progress. The early lead of energy operators in embracing digital transformation has enabled those systems to use digital transformation not only to enhance energy efficiency but also to lead the way to a lower-carbon, higher-efficiency economy that will enhance both energy and climate security.

This C3DTI Second Call for Proposals addresses the challenges for AI and Digital Transformation for Energy and Climate Security.

Areas of interest include but are not restricted to:

1. **Sustainability**: Applying AI/ML and advanced analytic techniques to support sustainability initiatives. Areas of focus may include scalable and trustworthy techniques for energy consumption analysis, supply chain and Scope 3 energy and emissions analyses (see [EPA Scope 3 Inventory Guidance](https://www.epa.gov/energy/inventory-guidance)), tracking water use across full-stream operations, and optimizing energy and water intensity of hydrocarbon production, storage, and transportation.

2. **AI for Carbon Sequestration**: Applying AI/ML techniques to increase the scale and reduce the cost of carbon sequestration. Areas of focus may include AI for advanced materials research to build better extraction of carbon dioxide (CO2) from the atmosphere, petrochemical process optimization for carbon capture, fossil fuel decarbonization, site-specific modeling of geophysical sequestration and emissions containment, and new sequestration technologies.

3. **AI for Leaks and Emissions Detection**: Applying advanced AI/ML techniques for large scale emissions detection, facility-level data reconciliation and gap analysis for emissions sensors, prediction of emissions risk, and analysis and optimization of flaring intensity across upstream and downstream operations.

4. **Safe Hydrocarbon Production and Transportation Infrastructure**: Applying analytic and AI/ML modeling techniques to increase the safety and reduce emissions from oil and gas extraction, petrochemical production, and hydrocarbon transportation. Areas of focus may include AI-based video and imaging algorithms to detect potential hazards and reduce accidents, with particular application in multi-modal sensing and drone-based real-time detection of methane and CO2 leaks, AI-based predictive maintenance, AI-enabled corrosion detection, AI-supported augmented reality systems for maintenance support, and next-generation AI-based digital twinning to support the modeling of hydrocarbon systems.

5. **AI for Advanced Energy and Carbon Markets**: Enabling dynamic, automated, and real-time pricing of energy generation sources. Areas of focus may include distributed resources, spinning reserve and voltage support, renewables, peer-to-peer energy transactions, improved energy and carbon price forecasting, and mechanism design to positively incentivize energy and carbon markets and prevent free riding and adverse selection.

6. **Cybersecurity of Power and Energy Assets**: Leveraging AI/ML techniques to improve the cybersecurity of our critical power and energy assets, as well as smart connected factories and homes. Areas of focus may include AI/ML for distributed hardware and network management, detection of anomalous network activity and log monitoring, and the cohesive analysis of hybrid Information Technology (IT) and Operational Technology (OT) systems.

7. **Smart Grid Analytics**: Applying AI and other analytic approaches to improve the efficiency and effectiveness of grid transmission and distribution operations. Areas of focus may include Volt/VAR optimization, non-technical loss reduction, predictive maintenance for the grid, accelerated outage detection and recovery, automated power routing, grid management given load profiles of Electric Vehicles, and improved control and operation of microgrids.

8. **Distributed Energy Resource Management**: Applying AI to increase the penetration and use of distributed renewables. Areas of focus may include improving grid efficiency with renewables, granular load forecasting, automated demand-response, appropriate policy design, and the optimal dispatching of distributed resources.

9. **AI for Energy-Efficient Buildings and Factories**: Leveraging AI techniques for advanced building and factory control to improve energy efficiency. Areas of focus may include AI-based motor control systems, advanced load disaggregation analyses, direct load control, and optimal pre-cooling or heating to minimize costs and stress on energy networks.

10. **AI for Improved Natural Catastrophe Risk Assessment**: Applying AI to improve modeling of natural catastrophe risks from future weather-related events (e.g., tropical storms, wildfires, floods). Areas of focus may include advanced asset vulnerability models, the prioritization of climate adaptation measures to enable rapid and more effective disaster recovery, and the appropriate portfolio and pricing of risk transfer solutions.

11. **Resilient Energy Systems**: Addressing how the use of AI/ML techniques and markets for energy and carbon introduce new vulnerabilities. Areas of focus may include detecting cyber-attacks, including Advanced Persistent Threats (APTs), mitigating the risks from such attacks, and operating resiliently through such attacks.

12. **AI for Improved Climate Change Modeling**: Using AI/ML to address climate change modeling and adaptation. Areas of focus may include deep-learning based fine-scale cloud models to enhance larger-scale climate models, circulation models of the stratosphere and troposphere, multi-scale modeling of weather phenomena, processes that govern climate variability and change, and methods to predict climate variations, extended weather, and climate predictability.

All proposals should be submitted online via EasyChair at: https://easychair.org/conferences/?conf=c3dticfp2

Proposals must be submitted to EasyChair before 11:59 pm PDT March 29, 2021.

Awards will be announced in late May 2021, with start dates of June 1, 2021.
C3DTI will host a series of online information sessions and to provide an overview of the call for proposals and discuss the computing resources available to Research Award recipients as well as office hours with technical staff. Below are the dates and times for each information session and details about office hours.

**General Information Sessions (Online)**

- **Monday, February 15, 11 am – 12 pm PT / 2 – 3 pm ET**
  Zoom Meeting: [https://berkeley.zoom.us/j/92742836523](https://berkeley.zoom.us/j/92742836523)
  - This online information session will provide an overview of the C3.ai DTI and the second call for proposals and provide an opportunity for proposers to ask questions or get clarification as they prepare proposals.

- **Wednesday, February 17, 11 am – 12 pm PT / 2 – 3 pm ET**
  Zoom Meeting: [https://berkeley.zoom.us/j/95629876415](https://berkeley.zoom.us/j/95629876415)
  - This online information session will provide an overview of the C3.ai DTI and the second call for proposals and provide an opportunity for proposers to ask questions or get clarification as they prepare proposals.

**Computing Resources Information Sessions (Online)**

- **Friday, February 19, 10 – 11 am PT / 1 – 2 pm ET**
  Zoom Webinar: [https://berkeley.zoom.us/j/96277461240](https://berkeley.zoom.us/j/96277461240)
  - This online information session will provide an overview of the C3 AI Suite and the available supporting resources.

- **Tuesday, February 23, 2 – 3 pm PT / 5 – 6 pm ET**
  Zoom Webinar: [https://berkeley.zoom.us/j/95880959454](https://berkeley.zoom.us/j/95880959454)
  - This online information session will take a deeper dive into the capabilities of the C3 AI Suite.

- **Tuesday, March 2, 10 – 11 am PT / 12 – 1 pm ET**
  Zoom Webinar: [https://berkeley.zoom.us/j/99845556376](https://berkeley.zoom.us/j/99845556376)
  - This online information session will discuss Ex Machina, a C3 AI tool that enables anyone to develop, scale, and apply AI insights without writing code.

**Weekly Office Hours (Online)**

Additionally, the C3DTI Development Operations and C3 AI technical support teams will be available every Tuesday from 2 – 3 pm PT / 5 – 6 pm ET between March 2 and March 23.

Zoom Meeting: [https://illinois.zoom.com.cn/j/87825348092?pwd=c1k1VWkxRXRQOTuWxTvUnNQ265Zz09](https://illinois.zoom.com.cn/j/87825348092?pwd=c1k1VWkxRXRQOTuWxTvUnNQ265Zz09)

Questions about general eligibility, proposal preparation, or research awards should be directed to the C3DTI by e-mail at proposals@c3dti.ai.

**Colloquium on Digital Transformation Science**
Mad Max: Affine Spline Insights into Deep Learning

Richard Baraniuk, Victor E. Cameron Professor of Electrical and Computer Engineering, Rice University

REGISTER FOR ZOOM WEBINAR

We build a rigorous bridge between deep networks (DNs) and approximation theory via spline functions and operators. Our key result is that a large class of DNs can be written as a composition of max-affine spline operators (MASOs), which provide a powerful portal through which to view and analyze their inner workings. For instance, conditioned on the input signal, the output of a MASO DN can be written as a simple affine transformation of the input. This implies that a DN constructs a set of signal-dependent, class-specific templates against which the signal is compared via a simple inner product; we explore the links to the classical theory of optimal classification via matched filters and the effects of data memorization. The spline partition of the input signal space that is implicitly induced by a MASO directly links DNs to the theory of vector quantization (VQ) and K-means clustering, which opens up new geometric avenue to study how DNs organize signals in a hierarchical and multiscale fashion.

Richard G. Baraniuk is the Victor E. Cameron Professor of Electrical and Computer Engineering at Rice University and the Founding Director of OpenStax. His research interests lie in new theory, algorithms, and hardware for sensing, signal processing, and machine learning. He is a Fellow of the American Academy of Arts and Sciences, National Academy of Inventors, American Association for the Advancement of Science, and IEEE. He has received the DOD Vannevar Bush Faculty Fellow Award (National Security Science and Engineering Faculty Fellow), the IEEE Signal Processing Society Technical Achievement Award, and the IEEE James H. Mulligan, Jr. Education Medal, among others.

Quick Links:
- C3.ai DTI Webpage
- Events
- Information on Call for Proposals
- Proposal Matchmaking
- C3.ai DTI Training Materials Overview (password protected)
- C3 Administration (password protected)

Have Questions? Please contact one of us:
- Jay Roloff, jayr@illinois.edu (Executive Director, c3.ai.DTI)
- R. Srikant, rsrikant@illinois.edu (Co-Director, c3.ai.DTI)
- Tandy Warnow, warnow@illinois.edu (Co-chief Scientist, c3.ai.DTI)

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