Data Institute for Societal Challenges

DISC

FY 2021 Year-End Report

University of Oklahoma
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https://ou.edu/disc

MESSAGE FROM THE DIRECTOR

Dear Colleagues,

The Data Institute of Societal Challenges (DISC) has officially hit its first year mark this past June. The vision of DISC is for the University of Oklahoma to be a nationally recognized leader for data science research and data-driven solutions to societal challenges. Our mission is to empower transdisciplinary research and collaboration to drive convergent solutions to societal challenges in Oklahoma, the nation, and the world through data science research, tools and capabilities.

DISC is playing a key role in the University's strategic plan, and especially in the research strategic plan. DISC is integrated into, and provides foundational capabilities to enable advancing the four research strategic themes: Aerospace, Defense and Global Security; Environment, Energy, and Sustainability; the Future of Health; and Society and Community Transformation. The four research strategic themes were created to address specific global challenges with convergent research partnerships using OU's expertise. We believe that this along with integration of DISC with the University's strategic plan, ensures focus, relevance, and opportunities for both impact and success.

The DISC team has continued to actively engage groups across campus, growing and connecting our data science community throughout its first year. DISC has also hosted a variety of workshops and events and has created numerous seed funding opportunities for OU researchers. This end of year report will provide an overview of what the DISC team and members accomplished in FY 2021.

Dr. David S. Ebert
Associate Vice President for Research and Partnerships
Director, Data Institute for Societal Challenges (DISC)
Gallogly Chair In Engineering
Professor, ECE and CS

DISC ORGANIZATIONAL STRUCTURE

DIRECTOR
Dr. David S. Ebert

MANAGING DIRECTOR
Yessenia Torres

MANAGERIAL ASSOCIATE
Amber Murray

RESEARCH ASSOCIATE
Luke Snyder

POSTDOCTORAL RESEARCHER
Dr. Audrey Reinert

ASSOCIATE DIRECTORS

Dr. Andrew Fagg
Computer Science & Bioengineering

Dr. Jennifer Koch
Geography & Environmental Sustainability

Dr. Erin Maher
Sociology

FACULTY FELLOWS

Dr. Jeong-Nam Kim
Journalism & Mass Communication

Dr. Chongle Pan
Microbiology & Plant Biology
Computer Science

Dr. Carrie Schroeder
Women's & Gender Studies

DISC is committed to achieving a diverse, equitable, and inclusive data science community by embracing and valuing each person's unique contributions, background, and perspectives. We acknowledge that data science and data-enabled research have been used to reinforce unjust social, political, and economic systems that have resulted in systemic discrimination and marginalization of certain groups. DISC will actively work to ensure that the scholarship in which we engage does not perpetuate these inequities and instead seeks to reduce them. We will develop inclusive, trust-based, collaborative teams that empower the voices of underrepresented groups. We will identify and help to address the issue of inequities and sources of bias in the broader data science community.

RESEARCH ADVANCEMENT EFFORTS

RESEARCH TEAM DEVELOPMENT ACTIVITIES

GRANT / RESEARCH * WORKSHOPS CO-HOSTED

34 Total Workshops Co-Hosted

649 Cumulative Workshop Attendance

* Includes NIH, NSF, DoD, Digital Humanities, DISC Meet & Greets, OU Big Idea Challenge

RESEARCH SEED FUNDING

In December 2020, **DISC created a research seed funding program** designed to incentivize transdisciplinary, convergent research teams focused on tackling grand challenges. Seed funding allows OU researchers to incubate ideas with the potential for future extramural support.

As of June 2021, DISC has awarded

11 OU Research Teams **71** OU Researchers

seed funding **TOTALING . . .**

$60K **3 Teams - $20K/Team**

- Sustainable / Holistic Refugee Resettlement Modeling
- Vaccine Misinformation / Disinformation
- Tribal Data Sovereignty

$40K **4 Teams - $10K/Team**

- AI for In-Situ Manufacturing Process Monitoring
- Decision Environment of Resilient Communities
- Wastewater Survey of Opioids / Illicit Drugs
- Predicting Extreme Seasonal Weather

$15K **2 Teams - $3K/Team**
1 Team - $4K
1 Team - $5K

- ML-Assisted Molecular / Coarse-Scale Dynamics
- Impact of Infective Endocarditis Treatment Clinic
- Blending Data Streams for Ecological Forecasts
- Accelerated Optoelectronic Materials Design

$115K **FY 2021 TOTAL SEED FUNDING AWARDED**

BIG IDEA CHALLENGE & EXTERNAL FUNDING PROPOSALS

OU's BIG IDEA CHALLENGE - FUNDING AWARDS

The OU Big Idea Challenge awarded projects "include team members from across disciplines and represent **exciting ideas for advancing OU research** in high-impact areas such as advanced energy technology, social justice and technology, environmental sustainability, and the well-being of children."

Ann West
Associate Vice President for Research and Partnerships

DISC Affiliates Granted

4 BIC Awards Totaling

$480K

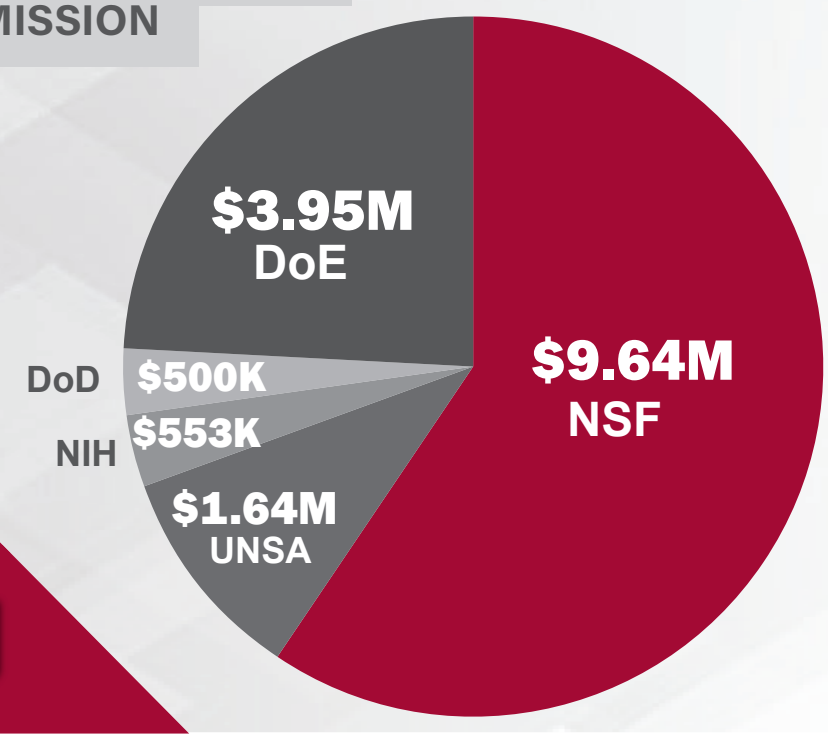
Social Media and the Visual Politics of Policing Communities of Color

X-GEM: Enhancing Future Community Sustainability via Greenhouse Gas Emission Monitoring

Well-Being Across the Lifespan: Early Childhood Experience and Opportunities in Oklahoma

Achieving Sustainability and Negative Carbon Emissions in an Agro-Energy Producing Region

DISC PARTNERSHIP IN EXTERNAL FUNDING PROPOSAL SUBMISSION



DISC has served as an active partner in the external proposal submittal process.

In FY 2021, DISC worked with transdisciplinary research teams on the submission of

10 PROPOSALS

with a total potential award value of

$16.3M

EXTERNAL FUNDING AWARDS

DISC FY 2021 EXTERNALLY FUNDED PROJECTS

4 ***Externally Funded Proposals Totaling*** **$2.64M**

(Funding Agencies: NSF, NATO, & UNSA)

1.

$1.64M

UNSA/OU Alianza Institute: Public Health Monitoring and Decision Making

Funding Agency & Partnering Institution: Universidad de San Agustin (Arequipa, Peru)

OU Researchers:
Dr. David S. Ebert
Dr. Dean Hougen
Dr. Hank Jenkins-Smith
Dr. Charles Nicholson
Dr. Talayeh Razzaghi
Dr. Carol Silva

This pilot project will evaluate the feasibility of a real-time, electronic, syndromic surveillance and decision-making system to provide (i) base data needed for accurate situational surveillance, virus spread status, and measurement of mitigation actions, and (ii) support for timely, data-, model-, and expertise-driven problem solving. These capabilities would be housed in an UNSA/OU Center for Integrated Public Health Monitoring, Analysis, and Decision-making (CIPH-MAD). Once the feasibility plan is in place, we will pilot data collection and modeling to establish a baseline for robust, dependable, and efficient public health monitoring and decision-making in Arequipa.

2.

$500K

NSF AI Institute: Planning: A Gap-Based Approach to Frame and Develop Robust AI for Sustainable Agriculture

Funding Agency: National Science Foundation (NSF)

Partner Institution: Purdue University, Arizona State, University of California, Santa Barbara, University of Iowa, Georgia Tech, and Northwestern University

OU Researchers:
Dr. David S. Ebert
Dr. Chris Fiebrich
Dr. Hank Jenkins-Smith
Dr. Amy McGovern
Dr. Berrien Moore III
Dr. Carol Silva

This project centers on the grand challenge of ensuring sustainable agricultural production and agricultural communities through advancements in plant and crop science, weather and climate forecast models, hydrologic models and water management tools, and most importantly, the integrated ecosystem of climate-food-water. The first aim of the project is to create a research, education, community engagement and deployment roadmap to guide the development of sustainable agriculture while helping growers understand the opportunities, issues, and approaches to effectively and reliably use AI techniques. The second is to develop educational material to promote AI-literacy among end-users, science researchers and citizens to ensure correct, robust and trustable development and deployment of AI-guided software and decision-making systems.

EXTERNAL FUNDING AWARDS CONT.

DISC FY 2021 EXTERNALLY FUNDED PROJECTS CONT.

4 ***Externally Funded Proposals Totaling*** **$2.64M**

(Funding Agencies: NSF, NATO, & UNSA)

3.

netwoRk for alErting And managing publiC safeTy & resilience - REACT

$454K

Funding Agency: North Atlantic Treaty Organization (NATO)

Partner Institutions: Ca 'Foscari University (Venice, Italy)
Ilia State University (Tbilisi, Georgia)

OU Researchers:
Dr. David S. Ebert
Dr. Audrey Reinert
Luke Snyder

This project will create an innovative pilot platform (REACT) for the rapid and effective management of scenarios immediately following a terrorist attack with chemical and biological (CB) agents as well as to control the diffusion of contamination over the space and time, short to-long term. The finalized system will be based on an intelligent and hierarchical network of sensors for real-time environmental monitoring integrated with social sensing, aimed to detect and track the evolution of exceptional events such as CB agents. The outcome will support public authorities and any other end-user with a new tool, autonomously implementable within their current procedures without conflict, for the rapid and effective management of unforeseen events involving CB agents.

4.

Collaborative: RAPID: Leveraging New Data Sources to Analyze the Risk of COVID-19 in Crowded Locations

$50K

Funding Agency: NSF

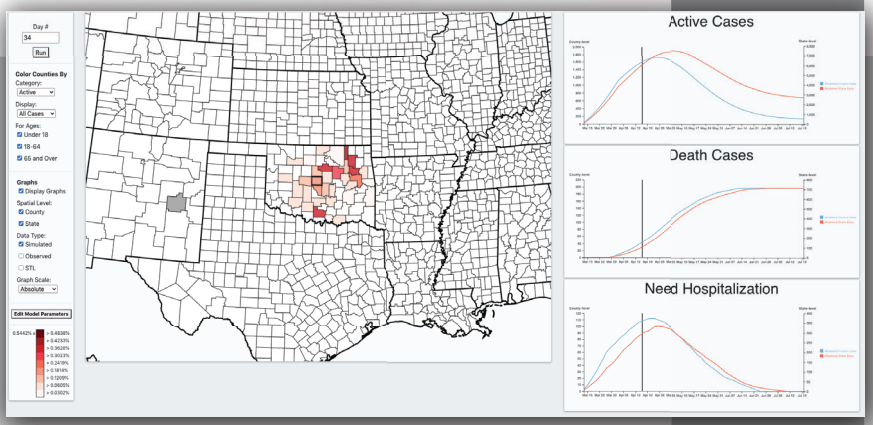
Partner Institution: Purdue University

OU Researcher:
Dr. David S. Ebert

The goal of this project is to create a software infrastructure that will help scientists investigate the risk of the spread of COVID-19 and analyze future epidemics in crowded locations using real-time public webcam videos and location based services (LBS) data. It is motivated by the observation that COVID-19 clusters often arise at sites involving high densities of people. This project will leverage novel data streams, such as public webcams and location based services, to inform the pedestrian dynamics model. Relevant data, models, and software will be made available to benefit other researchers working in this domain, subject to privacy restrictions. The project team will also perform outreach to decision makers so that the scientific insights yield actionable policies contributing to public health. The net result will be critical scientific insight that can generate a transformative impact on the response to the COVID-19 pandemic, so that it protects public health while minimizing adverse effects from the interventions.

DISC INTERACTIVE ANALYTIC SYSTEMS

PanViz 2.0



PanViz 2.0 is a visual analytics system that allows data analysts and the public to assess and track the spread of COVID-19 within the United States for improved decision-making. Multiple statistical epidemiological models are used such as SEIR (Susceptible-Exposed-Infective-Recovered), with geographic and population stratification to quantify and predict county-level disease spreading patterns. Further, PanViz 2.0 employs novel visualization approaches to refine an epidemic model's parameters dynamically, compare the predictions between multiple models, and conduct what-if analysis to assess the impact of different mitigation strategies.

"The PanViz product is an excellent tool to not only understand the impact COVID-19 is having on society, but more importantly how prevention and mitigation measures can make a difference. Another strength of the tool is that it incorporates data from multiple sources to improve its utility. Best of all, it's intuitive and easy to use."

Dr. Aaron Wendelboe

Assoc. Prof. of Biostatistics & Epidemiology in the College of Public Health at OU Health Sciences Center

SMART TECHNOLOGY

The **Social Media Analytics and Reporting Toolkit (SMART)** is an interactive web-accessible system created by DISC Director, Dr. David Ebert, and DISC Research Associate, Luke Snyder. SMART provides analysts with scalable and interactive social media analysis and visualization through topic extraction, a combination of filters, cluster examination, and stream categorization for increasing situational awareness during events such as natural disasters, mass public gatherings (e.g., college football games), and localized incidents using social media data (e.g., Twitter, Instagram). This software was funded by the U.S. Department of Homeland Center of Excellence Program, and the DISC team is currently adding new capabilities with funding from the NATO SPS program. SMART has been deployed to public safety and law enforcement agencies, including police departments, U.S. Coast Guard sectors, and fusion centers, for real-time monitoring and emergency management. SMART was recently used to augment emergency responder situation awareness during real-time events including the 2017 U.S. Presidential Inauguration, hurricanes Harvey, Irma, and Maria, and the 2018 and 2019 State of the Union addresses. OU researchers currently using SMART:

Dr. Jeong-Nam Kim (College of Journalism)
Investigating the spread and social dynamics of vaccine/COVID-19 misinformation on social media.

Dr. Shane Connelly (Psychology)
Dr. Shaila Miranda (Management Info. Systems)
Investigating the spread of vaccine/COVID-19 misinformation on social media.

Dr. Sherri Irvin (Philosophy)
Dr. Karlos Hill (African/African-American Studies)
Investigating social media attitudes towards racial hate crimes and police violence across different neighborhoods and time periods in the U.S.

DISC & DISC-MEMBER FY 2021 PUBLICATIONS

HIGHLIGHTED FY 2021 PUBLICATIONS* *(Publications are hyperlinked.)*

Abshirini, M., Saha, M.C., Altan, M.C., Liu, Y., Cummings, L., Robison, T. (2021). Investigation of Porous Polydimethylsiloxane (PDMS) Structures with Tunable Properties induced by the Phase Separation Technique. *Journal of Applied Polymer Science,* 138 (29): 50688.

Azfal, S., Ghani, S., Jenkins-Smith, H.C., Ebert, D.S., Hadwiger, M., Hoteit, I. (2020). A Visual Analytics Based Decision Making Environment for COVID-19 Modeling and Visualization. In *2020 IEEE Visualization Conference* (VIS) (pp. 86-90). IEEE.

Billings, C., Cai, C., Liu, Y. (2021). Utilization of Antibacterial Nanoparticles in Photocurable Additive Manufacturing of Advanced Composites for Improved Public Health. *Polymers,* 13(16): 2616.

Bray, M. T., Cavallo, S. M., & Bluestein, H. B. (2021). Examining the Relationship between Tropopause Polar Vortices and Tornado Outbreaks. *Weather and Forecasting*.

Chenin, J., & Bedle, H. (2020). Multi-attribute machine learning analysis for weak BSR detection in the Pegasus Basin, Offshore New Zealand. *Marine Geophysical Research, 41*(4), 1-20.

Ebert, D., Fisher, B., Gaither, K. (2021). Interactive Visual Analytics and Visualization for Decision Making Minitrack. In *Proceedings of the 54th Hawaii International Conference on System Sciences* (p. 1445).

Ebert D.S., Reinert A., & Fisher, B. (2021). Visual Analytics Review: An Early and Continuing Success of Convergent Research with Impact. *Computing in Science & Engineering, 23*(3), 99-108.

Guo, Y., Lee, S., & Kramer, M. (in press). We work in international companies: Affordances of communication media in Chinese employees' organizational socialization. Accepted for publication in *Communication Studies*.

Heidari, M., Lakshmivarahan, S., Mirniaharikandehei, S., Danala, G., Maryada, S. K. R., Liu, H., & Zheng, B. (2021). Applying a random projection algorithm to optimize machine learning model for breast lesion classification. *IEEE Transactions on Biomedical Engineering.*

Herren, B., Webster, V., Davidson, E., Saha, M.C., Altan, M.C, Liu, Y. (2021). PDMS Sponges with Embedded Carbon Nanotubes as Piezoresistive Sensors for Human Motion Detection. *Nanomaterials,* 11(7): 1740.

Hott, B. L., Brigham, F. J., & Peltier, C. (2021). *Research Methods in Special Education*. Slack Inc.

Lan, Q., Li, Y., Robertson, J., & Jin, R. (2021). Modeling of pre-transplantation liver viability with spatial-temporal smooth variable selection. *Computer Methods and Programs in Biomedicine, 208*, 106264.

. Not presented as a fully comprehensive list of DISC / DISC-Member FY 2021 publications.*

DISC & DISC-MEMBER FY 2021 PUBLICATIONS CONT.

HIGHLIGHTED FY 2021 PUBLICATIONS* CONT. *(Publications are hyperlinked.)*

Lee, C.H., Liu, Y., Moore, M., Xu, G., Siddique, Z. (2021). Enhancement of Stay-at-Home Learning for Laboratory Courses in Biomedical Engineering During COVID-19 Pandemic. *Biomedical Engineering Education,* 1, 149-156.

Lee, S. K., Kavya, P., & Lasser, S. C. (2021). Social interactions and relationships with an intelligent virtual agent. *International Journal of Human-Computer Studies, 150*, 102608.

Li, Y., Deng, X., Ba, S., Myers, W. R., Brenneman, W. A., Lange, S. J., ... & Jin, R. (2021). Cluster-based data filtering for manufacturing big data systems. *Journal of Quality Technology*, 1-13.

Lillo, S. P., Cavallo, S. M., Parsons, D. B., & Riedel, C. (2021). The role of a tropopause polar vortex in the generation of the January 2019 extreme Arctic outbreak. *Journal of the Atmospheric Sciences.*

Marashizadeh, P., Abshirini, M., Saha, M.C., Huang, L., Liu, Y. (2021). Interfacial Properties of ZnO Nanowire Enhanced Carbon Fiber Composite: A Molecular Dynamics Simulation Study. *Langmuir,* 37 (23):7138-7146.

Mirniaharikandehei, S., Heidari, M., Danala, G., Lakshmivarahan, S., & Zheng, B. (2021). Applying a random projection algorithm to optimize machine learning model for predicting peritoneal metastasis in gastric cancer patients using CT images. *Computer Methods and Programs in Biomedicine, 200,* 105937.

Noyori-Corbett, C., Moxley, D. P. (2021). Research Informed Competencies for Human Rights Field Education in Social Work. *Journal of Human Rights and Social Work, 6*(1), 59-66.

Noyori-Corbett, C., Moxley, D.P. (accepted March 2021). The United States Department of State Diplomacy Lab for Supporting MSW Students' Engagement in Community-Based Refugee Resettlement Research. *Journal of Social Work Education.*

Pineda-Castillo, S.A., Luo, J., Lee, H., Bohnstedt, B.N., Liu, Y., Lee, C.H. (2021). Effects of Carbon Nanotube Infiltration on a Shape Memory Polymer-based Device for Brain Aneurysm Therapeutics: Design and Characterization of a Joule-Heating Triggering Mechanism. *Advanced Engineering Materials,* 23(6): 2100322.

Reinert, A., Ebert, D.S. (2021). Humane Design for Inclusion. In *Proceedings of the 21st Congress of the International Ergonomics Association* (IEA) (pp. 307-316)

Reinert, A., Snyder, L.S., Zhao, J., Fox, A.S., Hougen, D.F., Nicholson, C., Ebert, D.S. (2020). Visual Analytics for Decision-Making During Pandemics. *Computing in Science & Engineering, 22*(6), 48-59.

. Not presented as a fully comprehensive list of DISC / DISC-Member FY 2021 publications.*

DISC & DISC-MEMBER FY 2021 PUBLICATIONS CONT.

HIGHLIGHTED FY 2021 PUBLICATIONS* CONT. *(Publications are hyperlinked.)*

Riedel, C.P., Cavallo, S.M. and Parsons, D.B., (2021). Mesoscale prediction in the Antarctic using cycled ensemble data assimilation. *Monthly Weather Review, 149*(2), pp.443-462.

Sharma, Y., Noyori-Corbett, C. (2021). Transnational Human Trafficking and HIV/AIDS among Women in Asia. *Social Development Issues.*

Shi, T., Jiang, H., & Zheng, B. (2021). C^2MA-Net: Cross-modal Cross-Attention Network for Acute Ischemic Stroke Lesion Segmentation based on CT Perfusion Scans. *IEEE Transactions on Biomedical Engineering.*

Snyder, L., Reinert, A., Ebert, D. (2021). Panviz 2.0: Integrating AI into visual analytics to adapt to the novel challenges of COVID-19. In *Proceedings of the 54th Hawaii International Conference on System Sciences* (p. 1457).

Tabbutt, K., Maher, E. J., & Horm, D. (2021). Foundations for Success: A Mixed-Methods Evaluation of a Statewide, Cross-Sector Early Childhood Collaborative. In *Child & Youth Care Forum* (pp. 1-25). Springer US.

Wang, G., Guo, J., Tang, M., de Queiroz Neto, J.F., Yao, C., Daghistani, A., Karimzadeh, M., Aref, W., Ebert, D.S. (2020). STULL: Unbiased Online Sampling for Visual Exploration of Large Spatio-temporal Data. In *2020 IEEE Conference on Visual Analytics Science and Technology (VAST)* (pp. 72-83). IEEE.

Wang, Y. F., Lee, S. K., & Ye, Q. (2021). Opinion leaders in eco-innovation diffusion: Analysis of information networks for waste separation in Shanghai. *Resources, Conservation and Recycling, 174,* 105822.

Yang, K.W., Chapman, S., Carpenter, N., Hammer, G., McLean, G., Doherty, A., Zheng, B., Chen, Y., Delp, E., Masjedi, A., Crawford, M., Ebert, C., Habib, A., Thompson, A., Weil, C., & Tuinstra, M.R. (2021). Integrating crop growth models with remote sensing for predicting biomass yield of sorghum. *in Silico Plants 3*(1), diab001.

Zhang, R., Lukasczyk, J., Wang, F., Ebert, D., Shakarian, P. Mack, E., Maciejewski, R. (to appear, 2022). Exploring Geographic Hotspots Using Topological Data Analysis. *Transactions on Geographic Information Systems*.

Zhao, Z., & Cheng, S. (2021). Capsule networks with non-iterative cluster routing. *Neural Networks.*

. Not presented as a fully comprehensive list of DISC / DISC-Member FY 2021 publications.*

DISC MEMBERSHIP & DATA SCIENCE COMMUNITY

OUR MEMBERS

DISC provides a variety of benefits to faculty, staff, and postdoctoral scholars who are interested in becoming a member. Active members have the opportunity to interact with an ever growing data science community at OU, as well as the following:

- **Grant development services**
- **Professional grant writing staff and technical consultants**
- **Support in developing and interpreting preliminary results**
- **Advice and support on large collaborative grant proposals**
- **Access to potential seed funding opportunities**
- **Letters of support**
- **Research promotion on the website, newsletters, and social media**
- **Mentorship opportunities for junior faculty**

44 MEMBERS
31 Faculty
5 Staff
3 Students
5 Post-Docs

OUR COMMUNITY

In early 2021, DISC developed a **Data Science Community Directory** accessible via DISC's OU webpage (https://ou.edu/disc). The directory is designed to help researchers, students, and staff connect across disciplines, and to facilitate team-building and partnerships at OU.

The directory is broken into research and educational interests, and provides contact information for those individuals working, or interested in specific data science fields of study or research. The research directory is further broken down into nine areas of data science focus:

- **Foundations & Privacy**
- **Software & Hardware Architectures**
- **Robust AI & Machine Learning**
- **Aerospace, Defense, & National Security**
- **Engineering & Manufacturing**
- **Energy, Environment, & Sustainability**
- **Business & Economics**
- **Life Sciences & Future of Health**
- **Humanities, Social Sciences, & Society / Community Transformation**

The directory currently includes contacts from **over 25 OU departments / colleges.** We hope to continue adding to our directory and assisting the data science community at OU in making those invaluable research and educational connections.

187 Directory Participants
122 Faculty
57 Students
8 Staff

DISC DIRECTION FOR THE FUTURE

ADVANCING THE MISSION OF DISC

The DISC team has grand plans for FY 2022 in keeping with the vision of establishing OU as a national leader in foundational and data-enabled research for aerospace, defense, and global security, community and societal transformation, the future of health, and the environment, energy, and sustainability.

DISC FY 2022 GOALS

View the *DISC Strategic Plan* **HERE**

- Expand OU's data science communities of practice
- Continue our commitment to provide support for developing data science and data-enabled research proposals
- Create a transdisciplinary, data science guest speaker program
- Develop a program of events to engage the public, OU community, and state agency leadership
- Establish a community and corporate affiliates program
- Increase our DISC membership by 25%
- Further support OU's data science research initiatives via our seed funding program
- Develop a DISC undergraduate data science research program in collaboration with programs across campus
- Continue hosting research team-building workshops in response to federal and state grant funding opportunities
- Increase our submitted funding applications in data science or data enabled research by 15%

CONNECT with DISC

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