Research and Education Programs in NSF Office of Advanced Cyberinfrastructure

Office of Advanced Cyberinfrastructure Division (OAC)
Computer and Information Science & Engineering (CISE)
National Science Foundation

Sushil K Prasad,
Questions: sprasad@nsf.gov

George Mason, Sept 2018

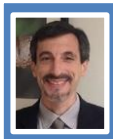
National Science Foundation
WHERE DISCOVERIES BEGIN

NSF Office of Advanced Cyberinfrastructure

Program Staff


Manish Parashar *
Office Director


Amy Friedlander
Deputy Office Director


Bill Miller
Science Advisor
(On Detail)

Computing	Data	Software	Networking & Cybersecurity	Learning & Workforce Development


Beth Plale *
Science Advisor
Public Access


Bob Chadduck


Amy Walton

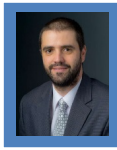

Vipin Chaudhary *


TBD


Sushil Prasad *


Alejandro Suarez
Cooperative Agreements


Ed Walker


Stefan Robila *


Rajiv Ramnath * (Part-Time)


Kevin Thompson


Scott Sellars
AAAS S&T Policy Fellow

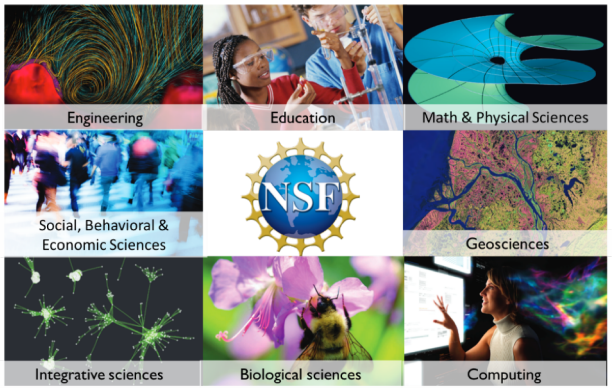
Join NSF/OAC: Multiple Program Officer openings

* IPA Appointment

CISE/OAC – Transforming the Frontiers of Science & Society

Foster a cyberinfrastructure ecosystem to transform computational- and data-intensive research across all of science and engineering

- Cyberinfrastructure Research & Research Cyberinfrastructure




CI-Enabled Instrumentation

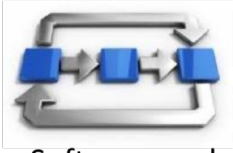

Computing Resources


Data Infrastructure


Gateways, Hubs, and Services


R&E Networks, Security Layers

Coordination & User support


Software and Workflow Systems

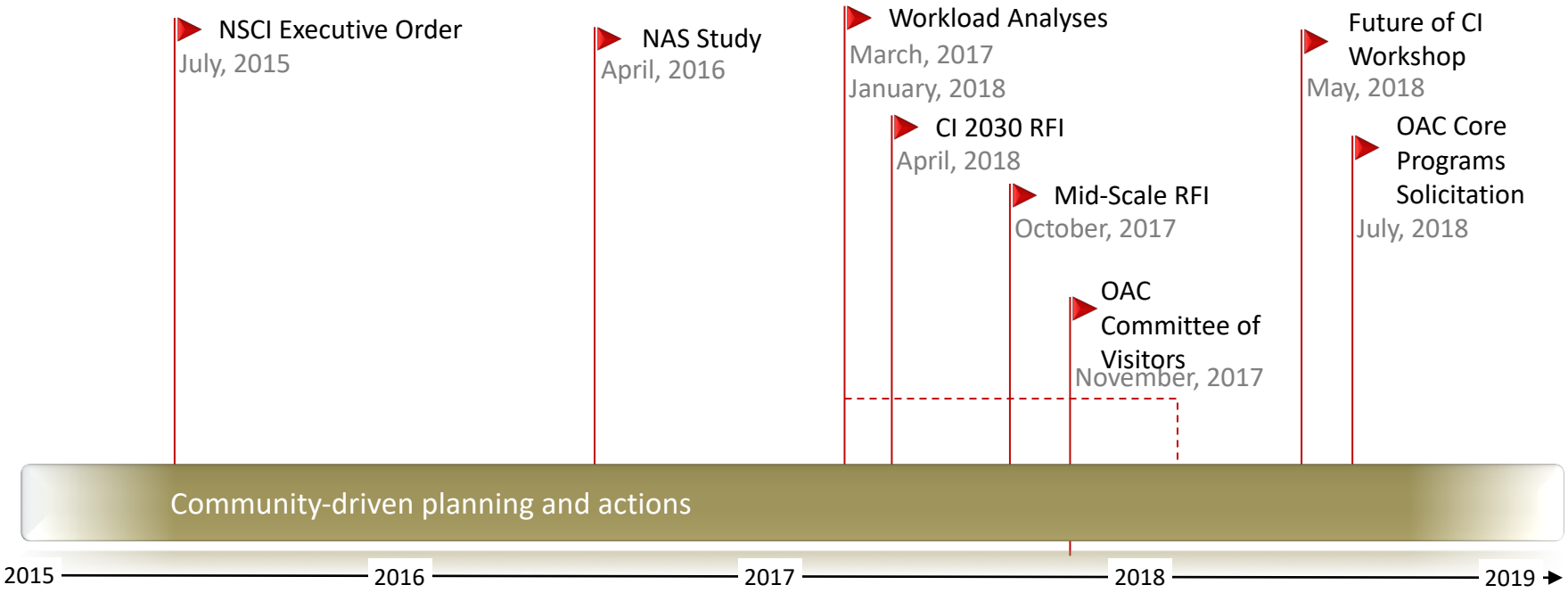

Pilots, Testbeds


People, organizations, and communities

CISE/OAC – Transforming the Frontiers of Science & Society

Computing	Advanced resources and services at all scales – MRI (clusters); Innovative HPC; Leadership Class; XSEDE coordination and user services; Research
Data	Data Building Blocks (DIBBS) Program
Software	Software Infrastructure for Sustained Innovation (SI2)
	Cyberinfrastructure for Sustained Scientific Innovation (CSSI)
Networking & Cybersecurity	Campus Cyberinfrastructure (CC*), International Research Network Connections (IRNC), Cybersecurity Innovation for CI (CICI)
Learning & Workforce Devel	Training-based Workforce Development for Advanced Cyberinfrastructure (CyberTraining), CAREER, CRII, OAC Core
Emerging Opportunities	Cyberinfrastructure for Emerging Science and Engineering Research (CESER), Public Access

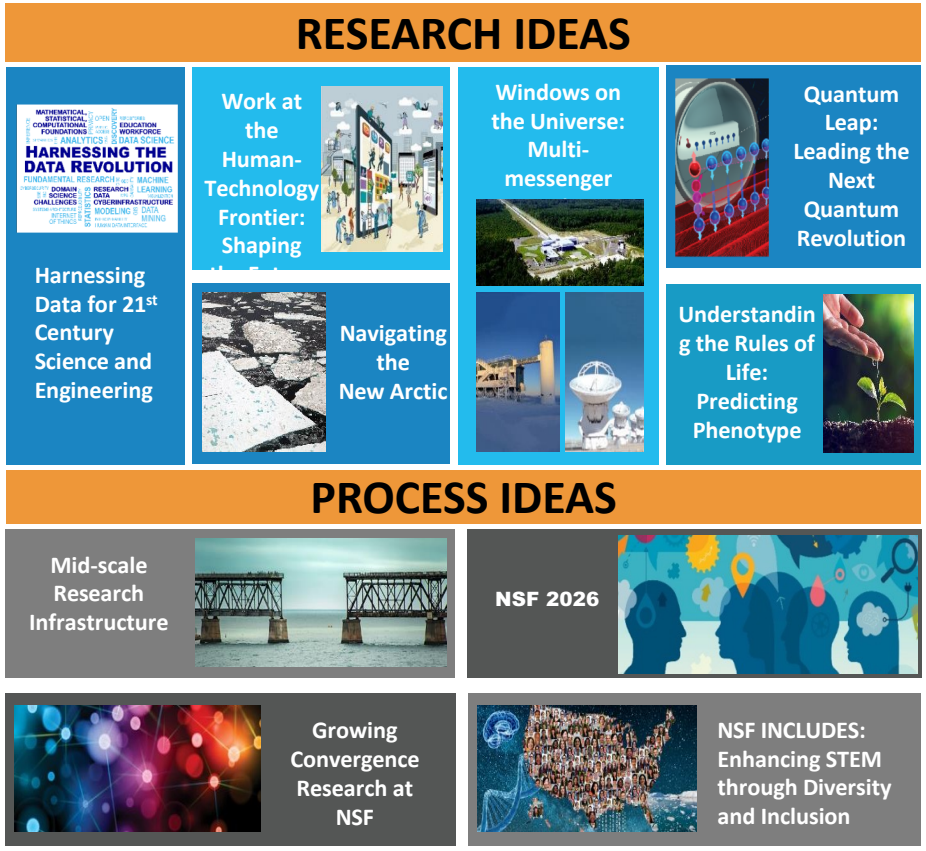
Planning for the Future CI Ecosystem



Key Drivers

- Changing application landscape & workload profile
- Changing technology, services landscape
- Increasing availability of (exp., obs.) data
- Growing role of ML, data-driven approaches

The NSF Big Ideas

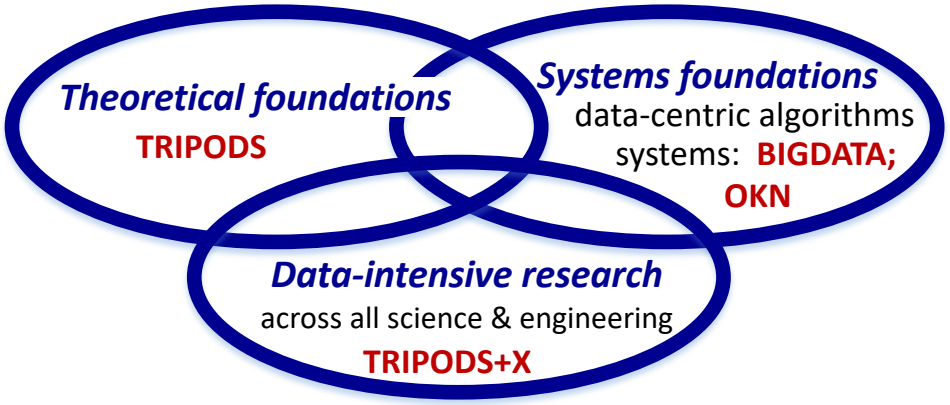


" … bold questions that will drive NSF's long-term research agenda -- questions that will ensure future generations continue to reap the benefits of fundamental S&E research. "

Big Ideas => Big Cyberinfrastructure Challenges & Opportunities

Harnessing the Data Revolution (HDR)

Research across all NSF Directorates



Educational pathways

Innovations grounded in an education-research-based framework
NASEM study on data science at the undergraduate level; NSF Research Traineeships; GRFP

Advanced cyberinfrastructure

Accelerating data-intensive research.
CSSI;
Scalable data-driven CI DCL;
Midscale infrastructure (Midscale RFI)

LWD: Communities of Concern

CI Contributors

Cyber Scientists
to develop
new capabilities

CI Professionals

Professional Staff
to deploy & support
new capabilities

CI Users

Area Scientists
to exploit
new capabilities

OAC

Learning and Workforce Development

Student Research Training

- REU SITES
- NRT

Faculty Research

- CRII
- CAREER
- Expeditions

Training/Workforce Development

- CyberTraining NSF 18-516
- Deadline Jan, 2019

OAC-Core Research Program

- New Solicitation NSF 18-567
- Deadline Nov 15, 2018

OAC-Core

OAC Core Research Program

SOLICITATION NSF 18-567

- Program Goals
  - Advanced Cyberinfrastructure (CI) research to impact the future capabilities of research CI
    - New knowledge in design, development, and utilization of robust research CI
  - Research career paths of cyber scientists/engineers
    - Computer as well as Computational and Data-driven Science and Engineering

OAC-Core

OAC Core Research Program

- Translational research
  - Spanning design to practice
  - All aspects of advanced cyberinfrastructure
- Possible other characteristics:
  - Multi-disciplinary,
  - extreme-scale,
  - driven by science and engineering research,
  - end-to-end, or
  - deployable as robust research CI

OAC-Core

OAC Core Research Program

Research Areas

- *Architecture & middleware for extreme-scale systems:*
  - Design, benchmarking, and analysis; storage, networks, and I/O;
  - Resource management, monitoring, fault tolerance, and cybersecurity
- *Scalable Algorithms and Applications:*
  - Numerical and high-performance scientific computing methods; Data, software and visualization; and Modeling and simulation
- *Advanced Cyberinfrastructure Ecosystem:*

  Programming languages, libraries, and environments; Tools; Sociotechnical aspects

OAC-Core

OAC Core Research Program

- Part of CISE's coordinated core program solicitations
- Only Small proposals in FY'19
  - Max $500K/award;
- Funding amount $7.5M
- Due Nov 15, 2018
- PI's *strongly encouraged* to send 1-page project summary for further guidance:
  - Sushil Prasad; Vipin Chaudhary; Stefan Robila
- Webinar held on Aug 7
  - Slides, audio recording posted

https://www.nsf.gov/events/event_summ.jsp?cntn_id=296101&org=CISE

Faculty Early Career Development Program (CAREER - NSF 17-537)

- Most prestigious award supporting junior faculty as a teacher-scholar
  - Outstanding research, education and the integration of education and research
    - Presidential Early Career Awards …(PECASE) – 20 best
  - Number of OAC submissions doubled in FY16 and tripled in FY'17
  - 30 active OAC awardees; Deadlines: CISE: July 2019
- More open to non-tenure track faculty; Sr. personnel allowed
- Min $400K/5 years, typically $500K

Faculty Early Career Development Program (CAREER – contd)

- OAC encourages proposals that are either of
  - primary interest to OAC, or
  - secondary interest to OAC (add OAC in Cover Page)
  - Dear Colleague Letter: ACI & CAREER (NSF 15-072)
    - http://www.nsf.gov/pubs/2015/nsf15072/nsf15072.jsp
- CAREER program page
  - http://www.nsf.gov/career
- CISE CAREER Proposal Writing Workshops
  - April 2016, http://carch.seas.gwu.edu/cise-career/NSF_2016.html
  - March 2017, Arlington: http://workshops.cs.georgetown.edu/CAREER-2017/
  - April 9, 2018, Alexandria: https://cisecareerworkshop.web.unc.edu/
    - Apply by March 10

Sangmi Lee Pallickara

CAREER: A Framework for Ad Hoc Model Construction in Data Streaming Environments

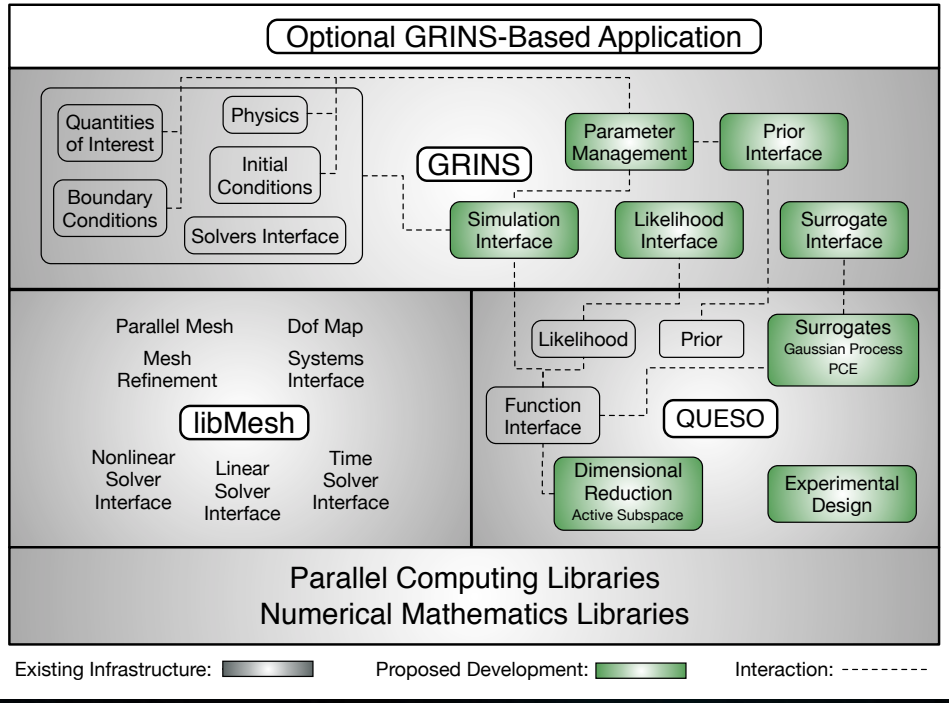
Colorado State University
http://www.cs.colostate.edu/~sangmi/
sangmi@cs.colostate.edu

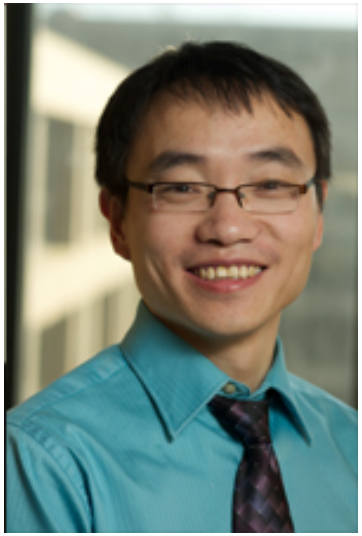
- Enabling infrastructure to support generation, assessment, and refinement of *ad hoc* models
  - From voluminous, multidimensional, time-series observational data at scale
  - Copes with the combinatorially explosive number of ways in which models can be realized
- Well suited for analytics of data streams generated in Internet-of-Things and Smart Communities
- Outreach: Computer Science STEM Camp for female high school students

CAREER: Cyberinfrastructure for Realizing Predictions with Uncertainty using Computational Modeling, Data, and Bayesian Inference

Paul T. Bauman
Mechanical and Aerospace Engineering
Computational and Data-Enabled Science and Engineering
University at Buffalo, Buffalo, NY

- Need for software infrastructure for statistical inference using complex, multiphysics models modern supercomputers
- Bring together GRINS, built on libMesh finite element library, with QUESO statistical library for inference of complex multiphysics FEM models
- RUNTIME selection of parameters, statistical surrogate development, etc.
- Developments major part of new CDSE Ph.D. program and new courses





Chunlei Liang

Computational Magnetohydrodynamics of the Sun

(1554005 – co-funded: OAC, DMS, GEO/AGS, CBET)

The George Washington University
chliang@gwu.edu

Research areas of this CAREER project: Liang takes novel engineering Computational Fluid Dynamics techniques to study solar convection zone. Research interests of the PI have included (but is not limited to): High-Performance Computing, Computational Mathematics, Fluid Dynamics, Magnetohydrodynamics, Helioseismology, Astrophysics, Marine Hydrodynamics (Liang is also an ONR YIP awardee) and more . . .

Unique Features of this CAREER project:

- **Novel engineering approaches of Computational Fluid Dynamics are being applied to study the Sun**
- **Substantial outreach activities for students to learn at the National Center for Atmospheric Research (including REU) and the George Washington University (including high-school summer programs).**

CISE Research Initiation Initiative (CRII - NSF 17-552)

- Independent research for faculty or *research scientists* in their first three years (Pre-CAREER)
  - May not have any grant as PI; 2 chances;
  - New: Chair letter certifies lack of essential resources
  - Tenure-track or research science or education position
- OAC research focus:
  - Advanced CI research: Translational, Use-inspired, multidisciplinary, End-to-end,
  - Computational and data-intensive scientists in addition to computer scientists
- Award ~$175K/ 2 yrs;
- Deadline: Aug 2019

Goals of CISE Research Initiation Initiative (CRII - contd.)

- Start a research program and career
  - The PI need not have significant prior research results or maturity
  - Start a path toward research independence
  - Develop collaborations within or across research disciplines
  - Undertake exploratory investigations
  - Acquire and test preliminary data
- Broaden community of researchers
  - Reach underserved sub-communities, under-represented groups, nontraditional institutions

CRII: ACI: Transforming semiautomatic patient-specific simulation workflows into autonomous medical imaging-through-analysis tools

Dominik Schillinger

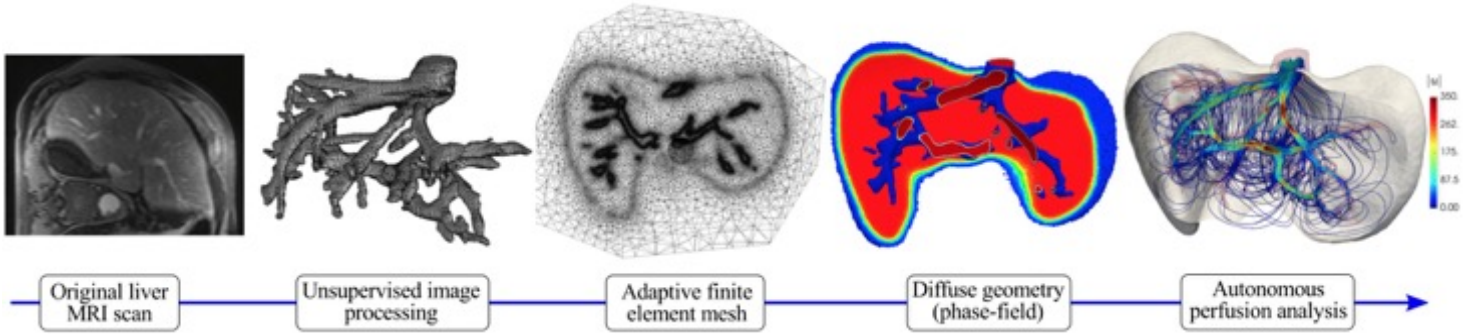
University of Minnesota, Twin Cities
dominik@umn.edu

Overarching hypothesis: To initiate *large-scale adoption* of patient-specific simulations in clinical practice, next-generation imaging-through-analysis tools need to *run autonomously* in hospitals.

Research objectives: This CRII project re-thinks the process of how imaging data are transferred into simulations. Develops new strategies that enable fundamental advances in the way finite element methods can *automatically interact with imaging data*.

Impact: Closer integration of patient-specific predictive simulation in clinical decision-making, significantly accelerating *transformation of healthcare* from reactive and hospital-centered to preventive, proactive, and evidence-based.

Autonomous perfusion analysis based on MRI of the liver (prototype)



Research Experiences for Undergraduates (REU - NSF 13-542)

- Active research participation by undergraduate students
- ***REU Sites*** are based on independent proposals
  - ***REU Supplements:*** component of new or continuing proposals
    - $8K/student for up to 2 students
- Deadline: August 2019 (4th Wed)
- Typically up to $360K/3yr

Research Experiences for Undergraduates (REU – Contd.)

School hosts summer cohort for undergrad research

- Coherent intellectual focus to research topics
- At least half the students are from institutions other than the host institution
- At least half from schools with limited research potential
- Research mentoring and support
- Social activities
- Professional development, grad school prep

Desirée Tullos

REU Site: EcoInformatics Summer Institute

Oregon State University & HJ Andrews Experimental Forest, OR

http://agsci.oregonstate.edu/eisi

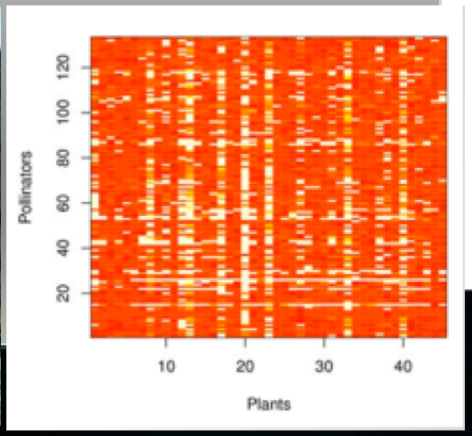
desiree.tullos@oregonstate.edu

Research areas of this site: The intellectual focus of the program is EcoInformatics, which unites theory and methods of informatics (e.g. computer science, mathematics, statistics, and engineering) with disciplines involving ecosystems (e.g. ecology, geography, geomorphology, botany, environmental sciences and management). Students work in teams to explore challenging natural resource management problems, extensive databases and complex ecosystem models, and new technologies for measuring ecosystems.

Site active since: 2006

Unique Features of the Site:

Combines field data collection with the application and development of informatics algorithms



Training-based Workforce Development for Advanced Cyberinfrastructure (CyberTraining) NSF 18-516 (replaced NSF 17-507)

Submission Deadline: Jan, 2019

Overarching Goals

- **Overarching Goal:**
  - *prepare, nurture and grow* scientific ***research*** workforce
  - ensure ***broad adoption*** of CI tools, methods, and resources
  - *integrate skills* into educational ***curriculum/instructional material fabric*** in
    - advanced cyberinfrastructure (CI) +
    - computational and data science and engineering (CDS&E)
    - spanning undergraduate and graduate courses.
- ***Innovative***, ***scalable training and education*** programs addressing
  - Emerging needs and Unresolved bottlenecks
  - Multidisciplinary communities
  - Undergrads, grad students, instructors, faculty, research CI professionals

NSF-wide Participation

- CISE/OAC - Office of Advanced Cyberinfrastructure **– lead**
  - Sushil K Prasad

  (Includes BD Hub)
- CISE/CCF Computing and Communication Foundation
  - Almadena Chtchelkanova
- EHR/DGE - Division of Graduate Education
  - Victor Piotrowski
- ENG - Directorates of Engineering
  - Joanne Culbertson, ENG/CMMI
  - Ronald Joslin, ENG/CBET
  - Anthony Kuh, ENG/EECS
- GEO - Directorate for Geosciences
  - Eva Zanzerkia
- MPS - Directorate for Mathematical & Physical Sciences
  - Bogdan Mihaila

- Intent: stimulate co-funding between OAC and one or more domains

FY 18: Award Framework

- Award Budget
  - $500K per award and up to 3 years in duration
  - About 25 awards made in FY 16 and FY17
- Communities of Concern:
  - CI Professionals (CIP), CI Contributors (CIC), CI Users (CIU)
- Consult OAC + other Cognizant Program Officers
  - At least one month in advance of the submission deadline
  - Mention consultation in the Project Summary
- Interested in serving in review panels?

Example Projects

- CI-professionals:
  - Training and certification of CI Professionals in cybersecurity technology and management for advanced CI-enabled research;
  - working with natural science researchers for advanced visualization, or for supporting scientific gateways;
- CI Contributors:
  - Training geoscience students to develop scalable software
  - Training the next generation of researchers on the NHERI DesignSafe Cyberinfrastructure with holistic computational models for future, adaptive buildings;
- CI Users:
  - Instructor training for computational science literacy across STEM disciplines in minimum core topics
  - Software and data literacy for natural science students

Other LWD Opportunities within OAC

- INTERN DCL (NSF 17-091)
  - Non-academic Graduate Student Research $50K/student
- EAGERs ($300K), Workshops ($50K), RCNs
  - Seed Exploration of Research, Training and Education, Broadening Participation
  - Students, Post-Docs, Faculty, CI Professionals
- Student Travel Grants
- *Discuss with me and other OAC Program Officers*
- To subscribe to *OAC Mailing List:*

  Send an email to:
  OAC-ANNOUNCE-subscribe-request@listserv.nsf.gov

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