

REPORT DOCUMENTATION PAGE

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RPPR Final Report
as of 07-Jan-2019

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INVESTIGATOR(S):

Name: George Karniadakis
Email: george_karniadakis@brown.edu
Phone Number: 4018631217
Principal: Y

Organization: **Brown University**

Address: Office of Sponsored Projects, Providence, RI 029129093

Country: USA

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Final Report for Period Beginning 30-Sep-2017 and Ending 29-Sep-2018

Title: MANNA 2017: Modeling, Analysis, and Numerics for Nonlocal Applications

Begin Performance Period: 30-Sep-2017

End Performance Period: 29-Sep-2018

Report Term: 0-Other

Submitted By: George Karniadakis

Email: george_karniadakis@brown.edu

Phone: (401) 863-1217

Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees:

STEM Participants:

Major Goals: The objective of MANNA was to unite the separate communities of fractional calculus and nonlocal calculus, allowing the participants to explore differences and similarities between them. A central goal was to gather together both senior and junior researchers conducting leading research on nonlocal models to exchange their recent progress and results and to propose future research guidelines. The workshop consisted of two parts: a course and a series of seminars by experts in the field.

Accomplishments: MANNA was very successful in establishing connections between the fractional calculus and nonlocal calculus communities. We are in fact aware of new collaborations and follow-up interactions between participants. As an example, one of the organizers visited three of the invited speakers and was invited to give a talk on fractional models at a minisymposium organized by one of the lecturers. She also started a collaboration on nonlocal vector calculus with one of the workshop speakers.

MANNA was well attended with 66 attendees.

The discussion session, held on Thursday December 14th was incredibly constructive. Both students and senior researchers contributed. The main focus was on open problems (e.g. discretization of nonlocal models, nonlocal boundary conditions, etc.) and on research opportunities and research guidelines for young researchers. Several students had the opportunity to present their work to senior people, including researchers working in US national laboratories; these interactions are very likely to lead to summer/year-round internships.

The course was also very useful for researchers not familiar with all the aspects of nonlocal research. Experts in fractional calculus could benefit from the lectures on more general nonlocal models and vice versa.

RPPR Final Report

as of 07-Jan-2019

Training Opportunities: AGENDA AND SPEAKERS

COURSE: December 11 - 12, 2017

The course deals with continuum models that involve nonlocal interactions. Central topics are modeling, analysis, algorithmic development, numerical analysis, and application of both fractional derivative models and models that necessarily cannot involve fractional derivatives.

Day 1 - 12/11/2017

Introduction to fractional order operators, Lecturer: Roberto Garrappa (University of Bari)

Introduction to anomalous diffusion models and applications, Lecturer: Diego del Castillo Negrete (Oak Ridge National Laboratory)

Mathematical analysis and numerics for fractional derivative operators, Lecturer: Mohsen Zayernouri (Michigan State University)

Mathematical analysis and numerics for fractional derivative operators (part I, part II), Lecturer: Abner Salgado (University of Tennessee at Knoxville)

Day 2 - 12/12/2017

Mathematical analysis and numerics for spatial nonlocal operators, Lecturers: Rich Lehoucq (Sandia National Laboratories)

Mathematical analysis and numerics for peridynamics, Lecturer: Pablo Seleson (Oak Ridge National Laboratory)

Introduction to peridynamics modeling and applications, Lecturer: David Littlewood (Sandia National Laboratories) Software Session

Lecturers: H. Antil (George Mason University), J.P. Borthagaray (University of Maryland), C. Glusa (Sandia National Laboratories), R. Garrappa (University of Bari), P. Seleson (Oak Ridge National Laboratory), M. Parks (Sandia National Laboratories), D. Littlewood (Sandia National Laboratories).

WORKSHOP: December 13 - 15, 2017

The workshop addresses topics across a wide range of problem areas involving spatial and/or fractional derivative and integral equation models, including (Tempered) Spatial fractional derivative models for convection-diffusion-reaction, and other applications; Integral equation models for convection-diffusion-reaction, and other applications; Integral equation models for solid mechanics, including visco-elasto-plasticity; (Tempered) Fractional time derivative and integral equation models for diffusion and complex fluids. For each topic, the modeling, analysis, algorithmic development and testing, and numerical analysis is considered.

Day 1 - 12/13/2017:

TALKS and POSTER SESSION, seminars by

V. Ervin, Clemson University

H. Antil, George Mason University

G. Acosta, University of Buenos Aires

B. Alali, University of Utah

S. Silling, Sandia National Laboratories

G. McKinley, MIT

H. Lei, Pacific Northwest National Laboratory

Day 2 - 12/14/2017:

TALKS AND DISCUSSION SESSION, seminars by

E. Nane, Auburn University

A. Sikorskii, Michigan State University

K. Diethelm, Technische Universität Braunschweig

H. Wang, University of South Carolina

M. Stynes, Beijing Computational Science Research Center

R. Lipton, Louisiana State University

A. Bonito, Texas A&M

Day 3 - 12/15/2017: seminars by

P. Bochev, Sandia National Laboratories

P. Radu, University of Nebraska

W. Deng, Lanzhou University

R. Garrappa, University of Bari

Y. Zhang, Missouri University of Science and Technology

N. Trask, Sandia National Laboratories

RPPR Final Report as of 07-Jan-2019

Results Dissemination: The website MANNA2017 is public and the link was sent, through mailing lists, to the entire community. There, one can find all the presentations (approved by the speakers) together with the list of participants, their affiliations, and contacts.

Honors and Awards: Nothing to Report

Protocol Activity Status:

Technology Transfer: Nothing to Report

PARTICIPANTS:

Participant Type: PD/PI

Participant: George Karniadakis

Person Months Worked: 1.00

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Funding Support:

Participant Type: Other (specify)

Participant: Marta D'Elia

Person Months Worked: 1.00

Project Contribution:

International Collaboration:

International Travel:

National Academy Member: N

Other Collaborators:

Funding Support:

Nothing to report in the uploaded pdf (see accomplishments).