

DNOISE III - the *next* step

Felix J. Herrmann

DNOISE II

DNOISE II matched contributions from 10 supporting organizations

- ▶ support of \$600 k (about 45% of total SLIM budget)
- ▶ broadening of research by including faculty & students from CS & Math
- ▶ allowed for growth & provided \$600k 1-time mid-term investment in HPC

Unique interdisciplinary research team delivered

- ▶ innovations in acquisition, processing & wave-equation based technology
- ▶ fundamental & applied contributions in exploration seismology, compressive sensing, and large-scale optimization
- ▶ training of HQP (13 PDFs, 8 MSc's, and 10 PhDs by project end in 2014)

DNOISE III – the next step

5-year project to continue successful interdisciplinary formula

- ▶ involvement of faculty from different departments

Aims to leverage (existing) public-private partnership by

- ▶ \$-4-\$ matching cash contributions 12–15 O&G companies **\$6.0 – 11.3M**
- ▶ matching of in-kind contributions from 3–5 HPC companies **\$1.2 – 2.0M**

Total budget

\$7.2 – 13.3M

NSERC contribution

\$4.2 – 7.7M

DNOISE III – goals

maintain interdisciplinary nature of our unique research program

consolidate our research program via sustained growth

establish a sustainable model for continued funding of HPC

diversify our research team to meet current & future challenges in computational exploration seismology

improve alignment with “industrial needs “ & “benefits to Canada”

calibrate balance between domain-specific geophysical research & broader computational data-science

expand our activities through international collaborations

DNOISE III – research objectives

Seismic data acquisition with compressive sensing:

- ▶ leveraging watershed moment of industry adapting randomized sampling
- ▶ **outcome:** continued innovation in support of WE based inversion

Wave-equation based inversion technologies:

- ▶ computationally feasible & versatile PDE-constrained optimization by incorporating more physics and by tackling fundamental issues such as sensitivity to starting models
- ▶ **outcome:** wave-equation based inversion capable of handling complicated wave physics and that is less sensitive to starting models & calibration

DNOISE III – research objectives

Technology validation on field data:

- ▶ validation of our technology on realistic blind synthetic and field data sets
- ▶ **Outcome:** a framework including to-be-developed workflows that allows for the technical assessment of DNOISE's technology on industry-scale problems

Supporting technologies for wave-equation based inversion:

- ▶ development of pre- and post-processing technologies in support of wave-equation based inversions
- ▶ **Outcome:** integration of seismic inversions with seismic data acquisition & reservoir modeling

DNOISE III – research objectives

Risk mitigation:

- ▶ put error bars on our processing & inversion results
- ▶ **Outcome:** formulation of randomized seismic data acquisition & processing methodologies that include information to mitigate perceived and implicit risks

Supporting theory:

- ▶ adapting & applying latest breakthroughs from mathematical and computer sciences towards the solution of current-day problems in computational exploration seismology
- ▶ **Outcome:** continued development of theory in support of pushing the envelope on wave-equation based exploration seismology

DNOISE III – research team



Andrew Calvert

Department of Earth Sciences
Simon Fraser University

Imaging and Interpretation: Quality of subsurface images derived from seismic reflection data, integration of geological and geophysical information.



Chen Grief

Department of Computer Science
The University of British Columbia

Scientific computing, numerical linear algebra: iterative solvers, saddle-point linear systems, preconditioning techniques.



Dominique Orban

Associate Professor of Continuous Optimization
Mathematics and Industrial Engineering Department
Ecole Polytechnique de Montreal

Computational mathematics: design and practical application of specialized numerical algorithms for continuous nonlinear optimization and systems of nonlinear equations, for image reconstruction, optimal structure design, PDE-constrained optimization.

DNOISE III – research team



Nick Harvey

Canada Research Chair in Algorithm Design
Department of Computer Science
University of British Columbia

Combinatorial optimization, discrete algorithms and randomized algorithms; On the more practical side, I have worked on many algorithmic problems arising in computer networking, including load balancing, data replication, peer-to-peer networks, and network coding.



Sudip Shekhar

Department of Electrical and Computer Engineering (*new hired 2013, formerly Intel*)
University of British Columbia

Circuits for high-speed I/O interfaces, silicon photonics, RF transceivers and sensor interfaces; Design of wireless, wireline and silicon photonics applications: biomedical technologies, communication systems, computer & software systems.



Yaniv Plan

New faculty fall of 2014, Formerly PDF U Michigan, Stanford, PhD Caltech

Department of Mathematics
University of British Columbia

Applied probability, high-dimensional inference, geometric functional analysis, random matrix theory, compressive sensing, matrix completion, big data analysis. A common challenge that I address in my research is how to find low-dimensional signals in big, noisy data, both in theory and practice.

DNOISE III – research team



Ozgur Yilmaz

Department of Mathematics
University of British Columbia

Applied and computational harmonic analysis, information theory, and mathematical signal processing. Mathematical problems related to analog-to-digital conversion; blind source separation; sparse approximations and compressed sensing, applications in seismic signal processing.

Collaborators:

Michael Friedlander (University of California, Davis)

Mike Warner (Imperial College London)

Ben Recht (University of Wisconsin)

Tristan Van Leeuwen (Utrecht University)

DNOISE III – research projects

Seismic data acquisition for wave-equation based inversion

Project leader: Felix J. Herrmann (PI), co-PI's Ozgur Yilmaz, Yaniv Plan, and Sudip Shekhar

Workflows for wave-equation based inversion

Project leader: Felix J. Herrmann (PI), co-PI/collaborator: Andrew Calvert (SFU)

Next-generation of wave-equation based inversion

Project leader: Felix J. Herrmann (PI)

Wave-equation based inversion & reservoir characterization

Project leader: [Felix J. Herrmann] (PI), co-PI's Chen Greif (CS, PDE constrained optimization), Nick Harvey (CS, randomized algorithms)

DNOISE III – research projects

Supporting projects:

- ▶ alternative formulations for PDE-constrained optimization
- ▶ wave simulations for inversion
- ▶ compressive sensing
- ▶ convex optimization & lifting
- ▶ stochastic optimization
- ▶ sketching
- ▶ randomized algorithms
- ▶ randomized linear algebra

DNOISE III – HPC plan

Succeeded in guaranteeing one-time \$600 K funding for HPC from NSERC

Sustained solutions are challenging

- ▶ CRDs are not meant to support infrastructure (HQP centric)
- ▶ Few alternatives in Canada with a \$50-100M HPC budget for all of Canada

Proposed solution

- ▶ change budget model into “HPC cycle” consumables to convince NSERC
- ▶ offset cash investments with in-kind contributions from HPC industry
- ▶ allow HPC industry to become “non-paying” SINBAD members

DNOISE III – proposal

Success of getting from NSERC hinges on

- ▶ quality of the research & merit of research team
- ▶ benefit to Canada – very important for non-Canadian companies

Need your help establishing benefits to Canada by describing

- ▶ the impact of DNOISE on your company's activities in Canada
- ▶ relationships between your company and major projects in Canada such as LNG in BC
- ▶ specific research or other activities your organization has in Canada

Incorporate this information in the proposal itself and in support letters

DNOISE III – Industry Partner Requirements:

Submission of a Form 183A:

- ▶ Identifies the collaborating industrial partner
- ▶ Identifies the Canadian activities of the industrial partner (if applicable)
- ▶ Quantifies the financial involvement of the industrial partner
- ▶ Due Aug 1, 2014

Submission of a Letter of Support:

- ▶ Describe the the industry's reason for supporting this research
- ▶ Describe collaborations
- ▶ Describe the industry's Canadian presence
- ▶ Reaffirm cash / in-kind contribution.
- ▶ Due Aug 1, 2014

DNOISE III – Form 183A

- ▶ Organisations participating in an NSERC Research Partnership Program must provide a "Form 183-A".
- ▶ Permits SINBAD consortium fee to be fully matched by research funding from the government of Canada.
- ▶ Signed by a representative of your company - or - **a representative of a Canadian subsidiary (if applicable).**

FORM 183A
Information Required from Organizations Participating in Research Partnerships Programs

Read the instructions before completing the Form.

GENERAL INFORMATION ON THE ORGANIZATION					
Name of organization			Name and title of contact person at the organization		
Mailing address			Mailing address for the contact person (only if different)		
Telephone number	Facsimile number		Telephone number	Facsimile number	
E-mail address			E-mail address		
Is your organization <input type="checkbox"/> Private sector? <input type="checkbox"/> Government owned? <input type="checkbox"/> Government agency/department?				Industry/Products and Services Code	
Is your organization <input type="checkbox"/> Profit-motivated? <input type="checkbox"/> Not-for-profit?				Web site	
Canadian ownership (in percentage) (If Applicable) %		Date of incorporation in Canada (If Applicable) /		Total number of employees in Canada	
Types of products sold and/or services offered			Total annual sales for previous year (If Applicable)		
			Net profit (loss) for previous year (If Applicable)		
Is your organization <input type="checkbox"/> a parent company? <input type="checkbox"/> a subsidiary of? (specify)					
RESEARCH AND DEVELOPMENT ACTIVITIES					
Does your organization have an R&D department? Yes <input type="checkbox"/> No <input type="checkbox"/>				Annual R&D expenditures	
If not, does it undertake R&D within the organization's premises? Yes <input type="checkbox"/> No <input type="checkbox"/>				(previous/ current / next year)	
Number of R&D staff in Canada Scientists and technicians:		R&D staff with a PhD:		/ /	
APPLICANT INFORMATION					
Family name		Given names		Initial(s) of all given names	
Title of proposal				Personal identification no. (PIN)	
				Appl ID (for NSERC use only)	
ORGANIZATION'S CONTRIBUTIONS					
Contributions to the direct costs of research	Year 1	Year 2	Year 3	Year 4	Year 5
a) Cash contribution					
b) In-kind contribution					
Has your organization received publicly-funded support for R&D directly related to the proposed project? Yes <input type="checkbox"/> No <input type="checkbox"/>			Are the applicant and co-applicant(s) at arm's length from your organization? Yes <input type="checkbox"/> No <input type="checkbox"/>		
Name, title and telephone number of authorized representative of the organization			Signature		Date


FORM 183A
Information Required from Organizations Participating in Research Partnerships Programs

Read the instructions before completing the Form.

GENERAL INFORMATION ON THE ORGANIZATION			
Name of organization CGG Services SA		Name and title of contact person at the organization Thomas Hertweck	
Mailing address CANADA: CGG Services (Canada) Inc. 715-5th Avenue SW, #2200 Calgary, Alberta T2P 5A2, CANADA		Mailing address for the contact person (only if different) CGG Services SA Horizon House, Azalea Drive Swanley Kent BR8 8JR United Kingdom	
Telephone number	Facsimile number	Telephone number	Facsimile number
E-mail address		E-mail address	
Is your organization <input checked="" type="checkbox"/> Private sector? <input type="checkbox"/> Government owned? <input type="checkbox"/> Government agency/department?		Industry/Products and Services Code 4304 (Applied Geophysics) 2302 (Petroleum eng. oil and gas recovery)	
Is your organization <input checked="" type="checkbox"/> Profit-motivated? <input type="checkbox"/> Not-for-profit?		Web site http://www.cggveritas.com/	
Canadian ownership (in percentage) (If Applicable) %	Date of incorporation in Canada (If Applicable) /	Total number of employees in Canada 	
Types of products sold and/or services offered		Total annual sales for previous year (If Applicable)	
		Net profit (loss) for previous year (If Applicable)	
Is your organization <input type="checkbox"/> a parent company? <input type="checkbox"/> a subsidiary of? (specify)		CGG Services SA	

RESEARCH AND DEVELOPMENT ACTIVITIES					
Does your organization have an R&D department?		Yes <input type="checkbox"/>	No <input type="checkbox"/>	Annual R&D expenditures	
If not, does it undertake R&D within the organization's premises?		Yes <input type="checkbox"/>	No <input type="checkbox"/>	(previous/ current / next year)	
Number of R&D staff in Canada Scientists and technicians:		<input type="text"/>		/ /	
		R&D staff with a PhD:			
APPLICANT INFORMATION					
Family name		Given names		Initial(s) of all given names	
Herrmann		Felix Johan		F. J.	
Title of proposal				Personal identification no. (PIN)	
DNOISE III (in collaboration with SINBAD Consortium):				264073	
				Appl ID (for NSERC use only)	
ORGANIZATION'S CONTRIBUTIONS					
Contributions to the direct costs of research	Year 1	Year 2	Year 3	Year 4	Year 5
a) Cash contribution	\$ XX,XXX	\$XX, XXX*	\$XX,XXX*	\$XX,XXX*	\$XX,XXX*
b) In-kind contribution		*cash contribution years 2-5 is subject to review			
Has your organization received publicly-funded support for R&D directly related to the proposed project?			Are the applicant and co-applicant(s) at arm's length from your organization?		
Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
Name, title and telephone number of authorized representative of the organization			Signature		Date

Form 183A (2009)

PROTECTED WHEN COMPLETED

Version française disponible



DNOISE III – Letters of Support - Due Aug 1

- ▶ on company letterhead; signed by representative
- ▶ the organization's support for and agreement with the proposal submitted to NSERC;
- ▶ the reasons for being involved in the proposed collaboration;
- ▶ how the organization expects to integrate the results into its operations or to otherwise benefit from the anticipated outcomes;
- ▶ the further effort required to exploit the results in Canada;
- ▶ the potential for benefit to the Canadian economy and the relevant time frame;
- ▶ the anticipated interaction of the organization's personnel with the university researchers;
- ▶ the anticipated contribution to the direct costs of the research, in cash and in-kind
- ▶ if applicable, a description of the organisation's Canadian R&D programs with details of any (Canadian) public funding received that is directly related to the application.

DNOISE III - submission of Letter of Support, F183A

Please return your signed letter of support and Form 183A

BY AUG 1, 2014

to Miranda Joyce (mjoyce@eos.ubc.ca) via email
or via fax to +1 604-822-6088.

Followed by mailing of paper original to address below:

Miranda Joyce

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Vancouver BC V6T 1Z4 Canada