

Special Notice 12-SN-0019
Special Program Announcement for 2012 Office of Naval Research
Basic Research Challenge (BRC):
“Co-Prime Sensor Array Signal Processing”

I. INTRODUCTION:

This announcement describes a research thrust, entitled “Co-Prime Signal Processing” to be launched under the ONRBAA12-001, Long Range Broad Agency Announcement for Navy and Marine Corps Science and Technology which can be found at <http://www.onr.navy.mil/Contracts-Grants/Funding-Opportunities/Broad-Agency-Announcements.aspx>. The research opportunity described in this announcement specifically falls under numbered paragraph 6 (Research Opportunity Description), Ocean Battlespace Sensing (Code 32) section, subparagraph 1) (c) (Undersea Signal Processing). This Basic Research Challenge Topic also falls under the following topics set forth under numbered paragraph 6 (Research Opportunity Description), “Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (Code 31)” number paragraphs 1 and 2. The submission of white papers and proposals, their evaluation and the placement of research grants will be carried out as described in that Broad Agency Announcement.

The purpose of this announcement is to focus attention of the scientific community on (1) the area to be studied, and (2) the planned timetable for the submission of white papers and proposals.

II. BACKGROUND

Introduction:

This Basic Research Challenge will establish the theoretical foundations of co-prime signal processing – a new waveform sampling strategy that offers the promise of simplified sensor array design, streamlined signal processing, and efficient image formation techniques. In the spatial domain, co-prime array designs have been used to extend the concept of minimally redundant sensor arrays, which span large apertures using far few elements than classical antenna theory dictates. For example, consider two uniform line arrays whose sensor spacing are $M\lambda/2$ and $N\lambda/2$, where λ is a wavelength, and M and N are co-prime integers (integers with no common factor other than unity). It can be shown that for spatially stationary fields, inference made using these two arrays is asymptotically equivalent to that which could be obtained using a fully populated array of MN elements spaced at the classical $\lambda/2$ spacing. Furthermore, even though the arrays contain only $M+N-1$ elements (one element can be shared), their co-array possesses a full MN degrees of freedom from which $O(MN)$ sources can be elucidated. The payoffs are two-fold: simplified, reduced cost array designs and significantly streamlined downstream processing.

Objective:

Although the preliminary results as stated above are promising, many open problems exist such as:

- How can the one-dimensional theory be extended to two-dimensional arrays?
- Can the concept be generalized to active systems such as communication systems, radar, and active sonar? Can transmitter waveform and receiver designs be jointly optimized within a co-prime mathematical framework?
- How is the system performance affected if random errors are introduced into element spacing?
- Can efficient imaging systems be implemented with co-prime based sensing strategies?
- What is the theoretical bound to the maximum number of sources that can be elucidated by two-dimensional sensing systems?
- How can the theory be generalized to sensing in multipath environments?
- Can co-prime sampling theory be generalized to sensing in multipath environments?
- Can co-prime sampling theory be used to develop efficient Fourier transform algorithms?

The Office of Naval Research hereby calls for white papers responding to the Co-Prime Signal Processing Basic Research Challenge topic. The Basic Research Challenge Program was established to competitively select and fund promising research programs in new areas not addressed by current programs. It stimulates new, high-risk basic research projects in multidisciplinary and departmental collaborative efforts, funds topics that foster leading edge science, and attracts new principal investigators and performers.

III. WHITE PAPER SUBMISSION

White papers should not exceed 2-3 single-sided pages exclusive of the cover page and a 2-3 page of principal investigator, and should be in 12-point Times New Roman font with margins not less than one inch. The cover page should be labeled “White Paper for ONR 2012 Basic Research Challenge: Co-Prime Sensor Array Signal Processing” and include the following information: title of the proposed effort, technical point of contact, telephone number, fax numbers, and e-mail address. The 2-3 page body of the white paper should include the following information: (1) Principal Investigator; (2) Relevance of the proposed effort to the research areas described in Section II; (3) Technical objective of the proposed effort; (4) Technical approach that will be pursued to meet the objective; (5) A summary of recent relevant technical breakthroughs; and (6) A funding plan showing requested funding per fiscal year. A resume of

the principal investigator, not to exceed 2 pages, should also be included after the 2-3 page body of the white paper.

Although not required, white papers are strongly encouraged for all offerors seeking funding. Each white paper will be evaluated by the Government to determine whether the technology advancement proposed appears to be of particular value to the Department of the Navy. Initial Government evaluations and feedback will be issued via e-mail notification from the Technical Point of Contact. The initial white paper appraisal is intended to give entities a sense of whether their concepts are likely to be funded.

Detailed Full Proposal (Technical and Cost volumes) will be subsequently encouraged from those Offerors whose proposed technologies have been identified through the above referenced e-mail as being of “particular value” to the Government. However, any such encouragement does not assure a subsequent award. Full Proposals may also be submitted by any offeror whose white paper was not identified as being of particular value to the Government or any offeror who did not submit a white paper.

For white papers that propose efforts that are considered of particular value to the Navy but either exceed available budgets or contain certain tasks or applications that are not desired by the Navy, ONR may suggest a full proposal with reduced effort to fit within expected available budgets or an effort that refocuses the tasks or application of the technology to maximize the benefit to the Navy.

White papers should be submitted electronically to the program technical points of contact, Dr. John Tague, John.A.Tague@navy.mil and Dr. Rabinder Madar, Rabinder.Madan@navy.mil. These white papers shall be in Microsoft Word or Adobe PDF format.

To ensure full, timely consideration for funding, white papers should be submitted **no later than Friday, 17 August 2012**. White papers received after that date will be considered as time and availability of funding permit.

The planned date for completing the review of white papers is **7 September 2012**.

V. FULL PROPOSAL SUBMISSION AND AWARD INFORMATION

Full proposals (including one technical volume and one cost volume) should be submitted under **ONRBAA12-001** by **21 September 2012**. Full Proposals received after that date will be considered as time and availability of funding permit.

ONR anticipates only **grants** will be issued for this effort. All full proposals must be submitted through www.grants.gov. The following information must be completed as follows in the SF 424 to ensure that the application is directed to the correct individual for review: Block 4a, Federal Identifier: Enter N00014; Block 4b, Agency Routing Number, Enter the three (3) digit Program Office Code (322) and the Program Officer’s name, last name first, in brackets ([Tague, John]). All attachments to the application should also include this identifier to ensure the proposal and its attachments are received by the appropriate Program Office.

ONR plans to fund eight to ten individual awards with a value of \$100,000 to \$150,000 per year, using Research funds. However, lower and higher cost proposals will be considered. The period of performance for projects may be from one to five years.

Although ONR expects the above described program plan to be executed, ONR reserve the right to make changes.

Selected projects will have an estimated award date of **01 January 2013**

VI. SIGNIFICANT DATES

Event	Date
Recommended White Paper Deadline:	17 August 2012
Informal Responses to Submitters *	7 September 2012
Recommended Full Proposal Deadline:	21 September 2012
Proposal Responses *	19 October 2012
Awards*	1 January 2013
First Annual Program Review:	February 2014

Note: * These are approximate dates.

VII. POINTS OF CONTACT

In addition to the points of contact listed in ONRBAA12-001, the specific points of contact for this announcement are listed below:

Technical Points of Contact:

Dr. John Tague, Code 322, Program Officer, John.A.Tague@navy.mil

Dr. Rabinder Madan, Code 311, Program Officer, Rabinder.Madan@navy.mil

Business Point of Contact:

Frank Kennedy Code 252 Contract Specialist, Frank.J.Kennedy@navy.mil

VIII. Submission of Questions

Any questions regarding this announcement must be provided to the Code 322 Program Officer Dr. John Tague, John.A.Tague@navy.mil or to Dr. Rabinder Madan, Rabinder.Madan@navy.mil. All questions shall be submitted in writing by electronic mail.

Answers to questions submitted in response to this Special Notice will be addressed in the form of an Amendment and will be posted to the following web pages:

- Federal Business Opportunities (FEDBIZOPPS) Webpage – <https://www.fbo.gov/>
- Grants.gov Webpage – <http://www.grants.gov/>

- ONR Special Notice Webpage - <http://www.onr.navy.mil/Contracts-Grants/Funding-Opportunities/Special-Notices.aspx>

Questions regarding **White Papers or Full Proposals** should be submitted NLT two weeks before the dates recommended for receipt of White Papers and/or Full Proposals. Questions after this date may not be answered.