

## Quick Reference

**Please note that you must read the full Call document for guidance before submitting your proposal**

### **University Defence Research Collaboration in Signal Processing, Phase 3 Application Themes: “Imaging and Detection through Complex Media” and “Electromagnetic Environment”**

**Call type: Invitation for proposals**

**Closing date: 16:00 on 4 September 2018**

**Funding Available:** Up to £2 million is available for this Call: £1 million for each theme for one or two grants in each theme area (depending on size).

**How to apply:** Full proposals through Je-S

**Assessment Process:** Applications will be considered in the same way as standard applications to EPSRC (see: <https://epsrc.ukri.org/funding/assessmentprocess/overview/>)

Applications will be sent to peer reviewers jointly selected by EPSRC and Dstl. Following the review stage competitive applications will be invited to a standard ICT grants panel for ranking. Applications to this Call will be ranked on separate lists (one for each Application Theme) from other standard applications allocated to that panel meeting. Peer reviewers and Panel Members will be referred to this document as part of their assessment.

### **Key Dates:**

<b>Activity</b>	<b>Date</b>
Deadline for Proposals	4 September 2018
Deadline for PI Response	19 October 2018
Funding decision	Wb 3 December 2018
Grant start date	1 January 2019

**Additional information:** Grants are expected to be of two or three years' duration. There is no limit on the number of submissions from individual organisations; institutional statements of support are not mandatory for this Call.

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# **University Defence Research Collaboration in Signal Processing, Phase 3 Application Themes: “Imaging and Detection through Complex Media” and “Electromagnetic Environment”**

**Call type:** Invitation for proposals

**Closing date:** 16:00 on 4 September 2018

**Related themes:** ICT

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## **Summary**

The aim of this Call is to fund one or two grants of up to £1 million and 3 years duration (depending on size) in each of two areas of signal processing of defence relevance:

- “Imaging and detection through complex media”
- “Electromagnetic environment”

EPSRC’s normal eligibility rules apply.

Applications will undergo peer review and will be ranked at the same ICT Theme Panel, but on separate lists (one for each Application Theme) from Standard proposals.

The Call is jointly funded by the UK Ministry of Defence (MOD). The Defence Science and Technology Laboratory (Dstl) will be involved in nominating reviewers and panel members to assist in peer review assessment. Dstl will also monitor the progress of the successful applications.

### Background

This Call is part of the third phase of EPSRC and MOD’s University Defence Research Collaboration in Signal Processing. During this initiative funding will proceed in two stages (see Figure 1). The first stage, completed in May 2018, was the funding of an Underpinning Signal Processing (USP) consortium grant to research fundamental principles and coordinate wider activities under the title “**Signal Processing in the Information Age**”. The USP consortium has a role in coordinating the community, and applicants to the current Call are expected to work with that consortium.

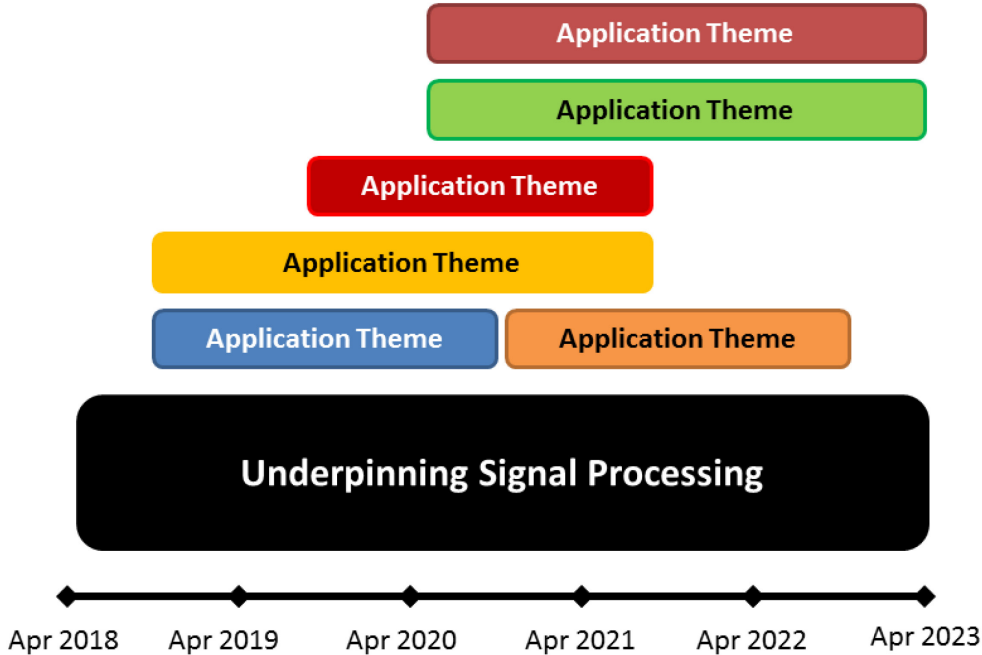


Figure 1: An illustrative Foundation + Themes model showing the relationship between application themed projects and the underpinning consortium (actual timelines may differ depending on number funded and timings of Calls). Note that while the start and end time for the Underpinning Signal Processing block is correct, those for the Themes are purely illustrative.

## Scope of the Call

This Call invites applications in two distinct Application Themes and £1 million is available for each Theme. These Application Theme projects will be of 2 or 3 years' duration. Each grant is expected to start and end within the lifetime of the Underpinning Signal Processing consortium grant and to have a role in exploiting research from it. Further Application Themed Calls will be issued later in 2018 and through the lifetime of the consortium grant.

The two Application Themes which are the subject of the current Calls are:

- "Imaging and Detection Through Complex Media" and
- "Electromagnetic Environment".

Applications should only address one Application Theme. Applicants may submit a second application for the other theme if they wish. Proposals that address both Themes in a single application will not be considered.

We encourage applicants to propose novel and innovative solutions within the Call scope.

We expect that all proposals will identify and seek to address defence and security applications of their research, but identification of other commercial applications is also encouraged.

### 1. Imaging and Detection through Complex Media

#### Aim and scope

This Application Theme covers imaging and detection in which the received signal has travelled through, or interacted with, a complex medium, before and/or after interacting with the object of interest. Such a medium may be inhomogeneous, have unknown dispersive, angular-dependent or other properties, and may be time-varying. For inverse scattering problems, this means the waves will have been multiply-scattered at points that are not known *a priori*. The resulting signal processing problem therefore often becomes a non-linear reconstruction one, in which the medium itself may have to be resolved in order to understand the data and extract target information.

#### Research needs

The Theme's sensing challenges have two key research focuses.

The first is in **development of reconstruction techniques suitable for sensing through complex media**. This includes imaging, as well as object detection, recognition and classification either before or after an imaging process. We welcome proposals in both direct and iterative (including Bayesian/statistical) reconstruction methods. Theoretical research in Inverse Problems is also encouraged, though all submissions must include an aspect of numerical implementation and experimentation. However, proposals involving machine-learning and artificial-intelligence will not be considered.

The second focus is on the use of **signal processing and reconstruction methods in the real world**. Safety is critical in many applications. The incorporation of sensing characteristics (such as resolution, sensitivity, probability of detection and false alarm rate) in non-linear reconstruction

methods may require significant advances in uncertainty quantification, which is crucial in the assessment of risk. How best to employ sensors, the limitations of the data gathered, as well as the additional and maximum information gained via new reconstruction techniques are important to understand within the context of realistic environments.

We expect applications to address a range of modalities or frequencies, which may occupy a span from low-frequency radar through to optical, and the different phenomenology and sensor limitations throughout this spectrum. Whilst we do not expect that proposal will cover the entire spectrum, we will expect applicants to cover a broad scope. This could be achieved through methods which are applicable to a wide range of problems.

Some motivating examples of tangible problems of current MOD interest in these research areas are available here:

<https://www.gov.uk/government/publications/university-defence-research-collaboration-in-signal-processing>

We are not expecting applications to address these specifically, but by providing these examples we hope to set the context of the research by outlining some of the challenges faced by Dstl which this Call seeks to address.

## 2. Electromagnetic Environment

### Aim and scope

This Application Theme considers information extraction and/or delivery of signals in contested electromagnetic environments. Both signal detection and transmission are of interest. Research is sought in algorithmic techniques both in the analogue and digital domains. Hardware solutions are out of scope for this Call.

### Research requirements

The Theme's challenges have two key research focuses.

The first is in **development of novel techniques to extract and utilise information content in signals captured in contested electromagnetic environments**. This includes rapid detection and classification of electromagnetic signals, potentially in an environment of multiple threat signals, multiple interferers and complex background. In such environments it will be critical to exploit opportunities for increased information extraction from non-stationary signals across time, frequency and space. High dimensions result in the curse of dimensionality so methods to perform classification of complex signals with reduced computational complexity are encouraged, for example use of sub-space techniques.

The second focus is on **development of novel techniques for signal transmission and reception in contested electromagnetic environments**. We are seeking applications that address software analogue and digital techniques to support signal transmission and reception. However, hardware solutions are out of the scope of this Call. Energy efficient signal disruption is of interest. Simultaneous Transmit and Receive (STAR) approaches have received recent attention in the literature and this would be in scope for proposals although the technical challenge here goes beyond that required for civilian applications. Precise spatiotemporal delivery of energy is of interest in this

research focus, where the aspiration is for improved delivery of effects by enabling the precise delivery and/or reception of radio signals in time and space. A challenge here is to overcome the non-linear effects of the electromagnetic and physical environments and or electromagnetic coupling physics.

Some motivating examples of tangible problems of current MOD interest in these research areas are available here:

<https://www.gov.uk/government/publications/university-defence-research-collaboration-in-signal-processing>

We are not expecting applications to address these specifically, but by providing these examples we hope to set the context of the research by outlining some of the challenges faced by Dstl which this Call seeks to address.

## **Application to data**

Application of results to suitable data is essential in addressing both the Application Themes, and Dstl will either advise on or provide such data wherever possible. It is acceptable to include small-scale experimentation and data collection in order to aid development and verification of techniques. However, we do not expect proposals to include a large proportion of time or budget on data collection. As a forward-looking research project, proposals should not be limited by near-term field-portable or low-SWAP (size, weight and power) computer power.

## **Funding available**

For each Application Theme there is £1 million available to fund one or two grants (depending on the size of the applications).

## **Equality, Diversity and Inclusion**

The long term strength of the UK research base depends on harnessing all the available talent and the Research Councils have together developed the ambitious UKRI Equality, Diversity and Inclusion Action Plan (<https://www.ukri.org/about-us/policies-and-standards/equality-diversity-and-inclusion/>).

In line with the UKRI Diversity Principles, EPSRC expects that equality and diversity is embedded at all levels and in all aspects of research practice. We are committed to supporting the research community in the diverse ways a research career can be built with our investments. This includes career breaks, support for people with caring responsibilities, flexible working and alternative working patterns. With this in mind, we welcome applications from academics who job share, have a part-time contract, need flexible working arrangements or those currently committed to other longer, large existing grants. Please see our Equality and Diversity webpages at <https://epsrc.ukri.org/funding/equalitydiversity/> for further information.

## **Equipment**

Equipment is not available through this Call.

## Eligibility

For information on the eligibility of organisations and individuals to receive EPSRC funding, see the EPSRC Funding Guide:

<https://epsrc.ukri.org/funding/applicationprocess/fundingguide/>

As this Call is a targeted funding opportunity provided by EPSRC, higher education institutions, and some research council institutes and independent research organisations are eligible to apply. A list of eligible organisations to apply to EPSRC is provided at: <https://www.ukri.org/funding/how-to-apply/eligibility/>

## How to apply

### Submitting an application

You should prepare and submit your proposal using the Research Councils' Joint electronic Submission (Je-S) System (<https://je-s.rcuk.ac.uk/>).

When adding a new proposal, you should select:

- Council 'EPSRC'
- Document type 'Standard Proposal'
- Scheme 'Standard Call'
- On the Project Details page you should select the 'UDRC Application Theme' Call.

Note that clicking 'submit document' on your proposal form in Je-S initially submits the proposal to your host organisation's administration, not to EPSRC. Please allow sufficient time for your organisation's submission process between submitting your proposal to them and the Call closing date. EPSRC must receive your application by **16:00 on 4 September 2018**.

Please note that you should ensure sufficient time to create Je-S accounts for both Principal Investigators and Co-Investigators and for these accounts to be verified by the institution at which you are based before submitting the application. See <https://je-s.rcuk.ac.uk/Handbook/pages/SettingupaJeSaccount/SettingupaJeSaccount.htm>

Guidance on the types of support that may be sought and advice on the completion of the research proposal forms are given on the EPSRC website (<https://epsrc.ukri.org/funding/howtoapply/>) which should be consulted when preparing all proposals.

### Guidance on writing an application

Full proposals documents must include: case for support, pathways to impact, justification of resources requested, a work plan. The structure of the Case for Support will follow normal EPSRC guidelines

<https://epsrc.ukri.org/funding/applicationprocess/preparing/writing/>



Applications should also be accompanied by a Cover Letter that clearly states the Application Theme being addressed, either "Imaging and detection through complex media" or "Electromagnetic environment" **but not both** as applications must address only one of the priorities.

Applicants should use the Ethical Information section on the Je-S form to demonstrate to peer reviewers that they have fully considered any ethical issues concerning the material they intend to use, the nature and choice, current public perceptions and attitudes towards the subject matter or research area. EPSRC will not fund a project if it believes that there are ethical concerns that have been overlooked or not appropriately accounted for. All relevant parts of the Ethical Information section must be completed. If the research will involve human participation or the use of animals covered by the Animals (Scientific Procedures) Act 1986 it is recommended that applicants pay particular attention to the guidance highlighted below. EPSRC reserves the right to reject applications prior to peer review if the Ethical Information sections are not completed correctly.

Further guidance on completing the Je-S form can be found at <https://je-s.rcuk.ac.uk/Handbook/pages/GuidanceonCompletingaStandardG/EthicalInformation.htm>. Other relevant guidance includes: EPSRC's policy on animal use in research (<https://epsrc.ukri.org/about/standards/animalresearchpolicy/>) and the Responsible Innovation Framework (<https://epsrc.ukri.org/research/framework/>).

Please note that on submission to EPSRC **all** non-PDF documents uploaded onto Je-S are converted to PDF, the use of non-standard fonts may result in errors or font conversion, which could affect the overall length of the document.

For advice on writing proposals see:

<https://epsrc.ukri.org/funding/howtoapply/preparing/>

## **Assessment**

### **Assessment process**

Applications received under this Call will be assessed by EPSRC in the manner of a standard application (see: <https://epsrc.ukri.org/funding/assessmentprocess/overview/>)

Applications will be sent to peer reviewers jointly selected by EPSRC and Dstl. Following the review stage competitive applications will be invited to a standard ICT grants panel for ranking. Applications to this Call will be ranked on a separate lists (one for each Application Theme) from other standard applications allocated to that panel meeting. Peer reviewers and Panel Members will be referred to this document as part of their assessment.

As stewards of funding on behalf of MOD, Dstl will be will be involved, alongside EPSRC portfolio managers, in the selection of referees for these applications. They will also be observers at the ICT Theme Panel but will not take part in the discussions of the applications or their ranking at the panel.

## **Assessment criteria**

Applications will be assessed against our standard criteria the definitions of which can be found here:

<https://epsrc.ukri.org/funding/assessmentprocess/review/formsandguidancenotes/standardcalls/>:

### **Quality/excellence (primary criterion)**

Reviewers are asked to comment on the degree of research excellence of the proposal making reference to:

- (1) The novelty, relationship to the context, and timeliness;
- (2) The ambition, adventure, and transformative aspects identified;
- (3) The appropriateness of the proposed methodology

### **Importance (secondary major criterion)**

As this Call is jointly funded by the Ministry of Defence, in this section reviewers will comment on the national importance of the research in the context of the Call. The standard questions on how the research:

- (1) Contributes to, or helps maintain the health of other disciplines contributes to addressing key UK societal challenges and/or contributes to future UK economic success and development of emerging industry(s);
- (2) Meets national needs by establishing/maintaining a unique world leading activity;
- (3) Complements other UK research funded in the area, including any relationship to the EPSRC portfolio

will be addressed in the context of how the proposed research advances the state of the art in defence-relevant signal processing science, provides exploitable solutions for defence, and builds and strengthens the UK defence signal processing community.

### **Pathways to Impact (secondary criterion)**

Reviewers will comment on the pathway to impact identified for this work particularly:

- (1) How complete and realistic are the impacts identified for this work;
- (2) The effectiveness of the activities identified to help realise these impacts, including the resources requested for this purpose;
- (3) The relevance and appropriateness of any beneficiaries or collaborators.

### **Applicant (secondary criterion)**

Reviewers will comment on the applicants' ability to deliver the proposed project making reference to:

- (1) Appropriateness of the track record of the applicant(s);

- (2) Balance of skills of the project team, including academic partners.

### **Resources and Management (secondary criterion)**

Reviewers will comment on the effectiveness of the proposed planning and management and on whether the requested resources are appropriate and have been fully justified.

### **Proposal Assessment (secondary major criterion).**

Reviewers are asked to comment on the extent to which this proposal meets each of the criteria laid out in the Call document not already covered by your previous answers.

### **Feedback**

Proposals will be treated as standard applications and will go through a postal peer review stage. Feedback will be sent in the form of reviewer forms prior to the prioritisation meeting and the rank order list information published on EPSRC's Grants on the Web (GoW) system shortly after the meeting. Occasionally there is specific feedback from the prioritisation meeting which will be passed to the applicant.

### **Guidance for reviewers**

Information about the EPSRC peer review process and guidance for reviewers can be found at: <https://epsrc.ukri.org/funding/assessmentprocess/review/>

Guidance for reviewing standard grants can be found here: <https://epsrc.ukri.org/funding/assessmentprocess/review/formsandguidancenotes/standardcalls/>

We are also asking for a view on the defence relevance of the proposed research. This should be addressed in the comments on Importance.

### **Additional grant conditions (AGCs)**

In addition to the standard terms and conditions for grants, successful applicants will be required to have a signed collaboration agreement with Dstl in place before the grant starts.

In accordance with the Government's aims for exploitation of the output of research work funded by the Research Councils, the research institutions within the funded consortium will be expected to claim title to the Intellectual Property resulting from the work and exploit the results. MOD shall have the right to free use of the results for defence purposes.

For projects funded by this scheme, the investigators may publish the results of the research in accordance with the normal academic practice. However, Dstl's prior consent to publication must be obtained.

There is also a Dstl requirement for quarterly progress reports from each grant, covering the work and successes of the project, together with an annual report from each grant.

Successful projects are expected to start on 1 January 2019.

## Moving forward

Submissions to this Call will count towards the Repeatedly Unsuccessful Applicants Policy. Further information about the policy can be found at: <https://epsrc.ukri.org/funding/howtoapply/basics/resubpol/rua/>

## Key dates

Activity	Date
Deadline for Proposals	4 September 2018
Deadline for PI Response	19 October 2018
Funding decision	Wb 3 December 2018
Grant start date	1 January 2019

\*EPSRC aims to adhere to the key dates as published; however, there may be exceptions where the sift, prioritisation or interview meeting may have to change due to panel member availability.

## Contacts

- Nigel Birch ([nigel.birch@epsrc.ukri.org](mailto:nigel.birch@epsrc.ukri.org) - Tel: 01793 444224)
- Jordi Barr ([jmbarr@dstl.gov.uk](mailto:jmbarr@dstl.gov.uk) – Tel: 01980 954441)
- Anna Walker ([anna.walker@epsrc.ukri.org](mailto:anna.walker@epsrc.ukri.org) – Tel: 01793 444476)

## Change log

Name	Date	Version	Change
Nigel Birch	11 July 2018	1	Timetable amended and link to additional information on Imaging & Detection added
Nigel Birch	13 July	2	Link to information on Electromagnetic Environments added

## Appendix: Je-S attachments Check List

### Standard:

Attachment Type	Maximum Page length	Mandatory/Optional	Extra Guidance
Case for Support	8 pages	M	Comprising up to two A4 sides for a track record, and six A4 sides describing proposed research and its context.
Pathways to Impact	2 pages	M	
Workplan	1 page	M	
Justification for Resources	2 pages	M	
CVs	2 pages each	As Required by EPSRC	For named and visiting researchers, and researcher co-investigators only.
Project Partner Letters of Support	No page limits	As Required by EPSRC	Must be included from all named project partners. Must be on headed paper, and be signed and dated within six months of the proposal submission date.
Letters of Support	No page limits	As Required by EPSRC	In exceptional circumstances a maximum of three letters can be submitted.
Proposal Cover Letter	No page limit	M	The cover letter should clearly state the application

			<p>theme being addressed.</p> <p>It can also be used to highlight any important information to EPSRC. This attachment type is not seen by reviewers or panel members.</p>
Other attachment	No page limit	As required, at EPSRC request only	<p>This can be used for a document that does not fit under any of the headings above. This attachment type is not seen by reviewers or panel members.</p>

Please ensure you adhere to the above attachment requirements when submitting your proposal. Any missing, over-length or unnecessary attachments may result in your proposal being rejected.