

2019年度 委託研究

課題199

国際共同研究プログラムに基づく
日米連携による脳情報通信研究

研究計画書



1. 研究開発課題

『国際共同研究プログラムに基づく日米連携による脳情報通信研究』

(Collaborative Research in Computational Neuroscience (CRCNS))

-Innovative Approaches to Science and Engineering Research on Brain Function-

2. 研究開発の目的と枠組み

研究開発の概要については、NSF（米国国立科学財団）と共通の内容であり、次のとおり。

Synopsis of Program:

Computational neuroscience provides a theoretical foundation and a rich set of technical approaches for understanding complex neurobiological systems, building on the theory, methods, and findings of computer science, neuroscience, and numerous other disciplines.

Through the CRCNS program, the National Science Foundation (NSF), the National Institutes of Health (NIH), the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF), the French National Research Agency (Agence Nationale de la Recherche, ANR), the United States-Israel Binational Science Foundation (BSF), and Japan's National Institute of Information and Communications Technology (NICT) support collaborative activities that will advance the understanding of nervous system structure and function, mechanisms underlying nervous system disorders, and computational strategies used by the nervous system.

Two classes of proposals will be considered in response to this solicitation:

- **Research Proposals** describing collaborative research projects.
- **Data Sharing Proposals** to enable sharing of data and other resources.

研究開発の枠組み:

本研究開発は、**CRCNS (Collaborative Research in Computational Neuroscience)** と呼ばれる枠組みの中で実施する。この枠組みは、脳情報に関する国際共同研究の推進のため、米国（NSFとNIH）が開始し、これに加え、ドイツ、フランス、イスラエルも追加参加して共同で実施する、ファンディングによる国際間共同研究フレームワークのことである。この枠組みに、日本（NICT）は昨年に続き今回（2期目）も参加する。米国はNSFを窓口にして評価後にファンド元がNSFかNIHのどちらかに決定される。ここでのCollaborativeの意味は、計算機科学、認知科学、工学、理論、神経生化学等様々な学問分野による共同研究のことである。

本公募では、日本と米国の両方の研究機関の参加が必須条件となり、日本と米国に加えイスラエルの研究機関も加わった共同研究も可能となる。(ただし、本公募では、ドイツ、フランスは含まれない。)

3. 採択件数、研究開発期間及び予算

採択件数 : 最大5件

研究開発期間 : 2019年度契約締結日（2019年夏を予定）から36か月間。ただし、委託研究の実施に36か月間が必要ないと提案者が判断する場合は、36か月間より短い期

間も提案可能であるが、その場合は日米双方とも同じ研究開発期間とすること。

研究開発予算 : 10百万円/12か月(税込)を上限とする。

(ただし、提案予算額の削減を行うことを条件として採択を決定する場合がある。)

研究開発体制 : 本公募は、少なくとも日米共同での研究開発プロジェクト(以下、「共同プロジェクト」という)であること。さらに、日本と米国に加え、イスラエルとの共同プロジェクト提案も可能である。なお、研究分野により、米国側ファンドはNSFかNIHとなる。また、日本側はNICTがファンドし、イスラエル側はBSFがファンドする。

4. 提案にあたっての留意点

【課題の選択】

本公募においては、

区分1 Research Proposals

区分2 Data Sharing Proposals

について、研究開発を行うものとするが、提案においては、区分1又は区分2のどちらかを選択することとし、選択した課題を提案書に記載すること。

【提案時における留意点】

提案者は、後述する到達目標を実現するための具体的な研究課題を設定し、かつそれら研究課題を担当する機関の役割分担を明確化して提案すること。また、提案には、最新技術動向を反映させることを求める。さらに、本公募は日米もしくは日米イスラエルによる国際共同公募であるため、次の事項に留意すること。

- NSFへの提案者との共同プロジェクトとして提案すること(イスラエルを含む場合は、3か国の共同プロジェクトとして提案すること)。提案者は、国立研究開発法人情報通信研究機構(NICT、以下「機構」という)(日本)及びNSF(米国)の両方に(イスラエルを含む場合はBSFにも)、それぞれに必要な応募書類を提出すること。(提案者が、国際共同プロジェクトがファンドを受ける機関全てに提案を提出していない場合は、当該提案は無効となり、評価の対象とならない。)
- 機構は共同プロジェクトの日本側研究機関に研究を委託し、各国の機関は、その国の研究機関に対して研究資金の提供を行う。
- 採択に関する評価は、日米及び各国が参加するCRCNS合同評価パネルで行う(詳細は応募要領を参照)。
- 採択後、研究開発の実施過程において、日本側研究機関は相手国側研究機関と共同して活動すること。

【提案書作成時の留意点】

提案書作成にあたり、次の事項に留意すること。

- 可能な限り定量的な目標を提案書に記載し、その数値目標を、どのような研究開発（要素技術の研究開発）を行うことによって達成するのか、スケジュールも含めて示すこと。
- また、定量的な目標として設定できない定性的な目標については、チャレンジなものを目標として設定し、どのような研究開発（要素技術の研究開発）を行うことによって達成するのか、スケジュールも含めて示すこと。
- 機構の保有する施設、テストベッド、クラウドサービス等を活用して本研究開発を実施することも可能であり、その場合は、使用を希望する施設等を提案書に記載すること。

5. 研究開発の到達目標

研究開発の到達目標については、NSFと共通であり、次のとおり。

Program Description:

Two classes of proposals will be considered in response to this solicitation: **Research Proposals** describing collaborative research projects, and **Data Sharing Proposals** to enable sharing of data and other resources. Domestic and international projects will be considered, as detailed in Sections V.A. and VIII of the Program Solicitation (NSF 18-501).

In general, appropriate scientific areas of investigations may be related to the missions and strategic objectives of any of the participating funding organizations. Some specific examples are given at the end of this section.

Each of the funding organizations participating in this program has a commitment to developing and supporting computational neuroscience research for the purpose of advancing the understanding of the neuroscience questions relevant to the missions of the organizations. Proposals selected for funding must be responsive to the mission of a participating funding organization.

Assurance of Innovative Collaborative Research Effort Across Scientific Disciplines: The driving principle behind this program is the recognition that projects crossing traditional academic disciplinary boundaries often bring about increased productivity, creativity, and capacity to tackle major challenges. Collaborative efforts that bring together investigators with complementary experience and training, and deep understanding of multiple scholarly fields, are a requirement for this program and must be convincingly demonstrated in the proposal. A typical research collaboration might involve a computer scientist and a neurobiologist, for example, though note that this solicitation does not prescribe any particular mix of disciplinary backgrounds or scientific approaches. Proposals

for research projects should describe collaborations that bring together the complementary expertise needed to achieve significant advances on challenging interdisciplinary problems. Proposals for data sharing should describe resources that respond to the needs of a broad community of investigators to enable wide-ranging research advances.

This program emphasizes innovative research and resources, encouraging the application and development of state-of-the-art computational methods by theorists, computational scientists, engineers, mathematicians, and statisticians to tackle dynamic and complex neuroscience problems.

Computational research supported under this program must relate to biological processes and should lead to hypotheses that are testable in biological studies. It is expected that: (1) research collaborations will build on complementary investigator expertise in computation or modeling, theory, and/or experimental neuroscience; (2) the collaborations should involve a dynamic and possibly protracted period of development and refinement of models, theories, and/or analytical techniques, and intense interactions among scientists and engineers from different disciplines; and (3) the development and testing of new models or theories should provide a framework for the design of experiments and the generation of new hypotheses that can help reveal mechanisms and processes underlying normal or diseased states of the nervous system.

Sharing of Data, Software, and Other Resources: Sharing of data and software is highly recommended in all CRCNS projects, to facilitate the translation and dissemination of research results, to accelerate the development of generalizable approaches and tools that can be put to wide use by researchers, and to broaden the scope of collaboration in computational neuroscience and related communities.

Data Sharing Proposals may relate to any of the scientific topics that would be appropriate for Research Proposals under this solicitation. Data sharing projects should be specifically aimed at the preparation and deployment of data, software, code bases, stimuli, models, or other resources in a manner that is responsive to the needs of a broad community of researchers, for example, by providing a coherent collection of data and other resources covering a set of topics, systems, or methods of interest. The major innovation and intellectual merit of a data sharing proposal could be in the breadth, depth, or importance of the resources being shared. Technical innovation (e.g., to facilitate usability, access, and integration), and thoughtful approaches to community development and continuous improvement, are encouraged as needed to make the proposed resources maximally effective. CRCNS support for data sharing focuses primarily on data and other resources, not more general infrastructure, or research to acquire the data. Proposers of data sharing projects are strongly encouraged to build on existing facilities and services where possible, rather than develop infrastructure from scratch.

All CRCNS investigators are encouraged to coordinate with other data sharing projects and related activities, including national and international efforts to develop sustainable, extensible neuroscience resources. Further information about resources for data sharing is available on the CRCNS program web site (<http://www.nsf.gov/crcns/>).

Innovative educational and training opportunities are highly encouraged, to develop research capacity in computational neuroscience, broaden participation in research and education, and increase the impact of computational neuroscience research. Activities at all levels of educational and career development are welcome under this solicitation. International research experiences for students and early-career researchers are highly encouraged in all projects involving international collaborations.

A broad range of topics and approaches is welcome under this solicitation. The following list of examples illustrates some areas of research that are appropriate under this solicitation. **This list is not intended to be exhaustive or exclusive.**

- Explanatory, predictive, and informative models and simulations of normal and abnormal structures and functions of the nervous system and related disorders;
- Mathematical, statistical, and other quantitative analyses of research related to genetic, epigenetic, molecular, sub-cellular, cellular, network, systems, behavioral, and/or cognitive neuroscience;
- Theoretical and computational approaches to delineate and understand the structures and functions of neural circuits and networks;
- Theoretical and computational approaches that relate nervous system processes to learning algorithms, probabilistic representations, estimation, prediction, information theory, and inference;
- Data-driven and informatics-based approaches that exploit large-scale, high-throughput, heterogeneous, and/or complex data;
- Theory and algorithms for designing experiments and integrating and analyzing data related to imaging and brain mapping technologies, including microscopic, macroscopic, and multimodal methods;
- Modeling approaches that efficiently assimilate new information, apply existing knowledge to new data, or optimize new data acquisition or closed-loop system performance;
- Machine learning algorithms combined with effective explanatory techniques mining neuro-behavioral data and linking multiple neuro-behavioral measures;
- Methods for measuring and analyzing connectivity, dynamics, information, and causation in neural systems;
- Explanatory models of spatiotemporal brain dynamics across multiple scales;
- Approaches exploiting new methods and tools for simulating complex multi-physics, multi-scale systems;
- Approaches that integrate neural and cognitive models;

- Data-intensive approaches to modeling and analysis, and integrated theory- and data-driven models at different levels of abstraction;
- Efforts to compare large-scale experimental data to theoretical and computational models;
- Mathematical, statistical, and modeling approaches arising from areas such as communications, network science, the social, behavioral, and economic sciences, engineering, and other fields;
- Multi-scale modeling spanning temporal scales, spatial scales, biological scales, and states (e.g., behavioral, normal, and diseased states) to understand and predict processes, behaviors, and diseases;
- Theoretical and computational methods that can be applied to: common pathways, circuits, and mechanisms underlying multiple diseases in the nervous system; translational research including therapeutic devices and drug development; and/or clinical research and clinical trials (e.g., predictive models of diseases, adaptive design of clinical trials, and simulation of clinical trials);
- Computational approaches to optimize the predictive power of quantitative systems pharmacology, integrating data across multiple scales including, for example, genomics, systems biology, clinical phenotypes, and therapeutic candidate characteristics;
- Theoretical and computational methods that can be applied across multiple areas of basic, translational, and clinical neuroscience research;
- Development and dissemination of analytical, numerical, or conceptual predictive models;
- Theoretical, computational, and/or analytical approaches to integrating brain measures across levels of analysis (e.g., molecules, cells and circuits); and
- Approaches to neuroscience problems that advance computational and engineering principles. Examples of topics amenable to these approaches include but are not limited to the following:
 - Neurodevelopment, neurodegeneration, neuroinflammation and repair;
 - Pattern recognition and perception;
 - Motor control mechanisms and sensorimotor integration;
 - Learning, representation, and encoding;
 - Cognitive and decision-making functions and dysfunction, including, e.g., impulse control and disinhibition;
 - Neural origins of risk and time preference;
 - Judgment, choice formation, and social-behavioral phenomena such as trust, competitiveness, and cooperation;
 - Language and communication;
 - Intellectual and developmental disabilities;
 - Neural interface decoding and analysis, control, and modeling of processes affecting neural interfaces and neuroprostheses;
 - Normal and abnormal sensory processing (vision, audition, olfaction, taste, balance, proprioception, and somatic sensation);
 - Neurological, neuromuscular, and neurovascular disorders;

- Mental health, mental illness, and related disorders;
- Alcohol and drug abuse related disorders, including, e.g., their interaction with eating disorders and other psychiatric and neurological disorders;
- Emergent and state-space properties of dynamic neural networks and ensembles; and
- Modulation of central and/or peripheral neural processes by complementary and integrative health approaches (mind and body interventions, natural products), in particular in the context of pain processing and regulation.

6. 研究開発の運営管理及び評価について

【運営管理】

- 研究開始時には、国内の受託者のみを対象に、スタートアップミーティングを実施することで、受託者は必ず出席し、実施計画書に基づき研究内容を説明すること。
- 本研究開発課題を国際共同プロジェクト一体として推進することを目的に、機構は必要に応じて個別課題間あるいは各国間の連携を議論・調整する会合を開催する場合がある。受託者はこれらに必ず出席し、連携の推進を図ること。
- また、CRCNS各国の受託者が参加するPI*会合を数回開催する予定であり、開催場所は米国あるいはCRCNS各国を予定しているため、受託者はこれらに必ず出席すること。
- 機構は、上記以外にも研究開発の進捗状況を把握するために、ヒアリングを実施する場合がある。

【機構との連携】

- 本研究開発課題と、機構における自主研究開発との連携を図るため、適宜、進捗などについて機構と調整を行うこと。また、連携を図るため、受託者は機構との連絡調整会議を定期的に設定すること。

【評価】

- 機構は、研究終了時に終了評価を行う。この評価は、国内の受託者のみを対象とし、他国の受託者は対象としない。
- 機構は、研究開発終了後3年後及び5年後に成果展開等状況調査を実施するとともに、その結果を踏まえ、追跡評価を行う場合がある。

7. 参考

本研究開発のテーマとなる脳情報通信研究に関する参考情報が、以下に取りまとめられている。

- [1] 関連する研究内容の紹介： CiNet <http://cinet.jp>
- [2] 過去の採択課題情報（NSF の最近の CRCNS に関する受託者の公開情報）：
https://www.nsf.gov/cise/funding/crons_awards_all.jsp?WT.si_n=ClickedAbstractsRecentAwards&WT.si_x=1&WT.si_cs=1&WT.z_pims_id=5147&

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