2021年度 委託研究

課題221

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（第4回）

研究計画書

国立研究開発法人
情報通信研究機構

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（第4回）』

（Collaborative Research in Computational Neuroscience（CRCNS）

—Innovative Approaches to Science and Engineering Research on Brain Function—）

２．研究開発の概要とフレームワーク

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 U.S. National Science Foundation (NSF), National Institutes of Health (NIH), and Department of Energy (DOE); 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); Japan's National Institute of Information and Communications Technology (NICT); and Spain's State Research Agency (Agencia Estatal de Investigación, AEI) and National Institute of Health Carlos III (Instituto de Salud Carlos III, ISCIII) 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.

研究開発のフレームワーク:

本委託研究は、**CRCNS（Collaborative Research in Computational Neuroscience**）と呼ばれるフレームワークの中で実施する。このCRCNSは、脳情報に関する国際共同研究の推進を目的に、米国（NSF、NIH、DOE）、ドイツ（BMBF）、フランス（ANR）、イスラエル（BSF）、日本（NICT）、スペイン（AEIとISCIII）が参加して、それぞれが研究資金を提供する国際共同研究フレームワークである。

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。

３．研究開発の到達目標

研究開発の到達目標については、NSFと共通の内容であり、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 this solicitation.

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. Questions concerning a particular project's focus, direction, and relevance to a participating funding organization should be addressed to the appropriate person in the list of agency contacts.

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 computing, engineering, 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 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 an identified 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.

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 list of examples below illustrates some areas of research that are appropriate under this solicitation. **The**

following 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;
- High Performance Computing (HPC) enabled modeling and simulation approaches for extreme scale research and understanding;
- Theoretical and computational approaches that relate nervous system processes to learning algorithms and architectures, 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, electrophysiological, optogenetic, multi-omic, and other methods;
- Artificial intelligence and machine learning approaches adopting life-long learning, transfer learning, and other strategies for building, generalizing, or selecting models based on accumulating and diverse forms of evidence;
- 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;
- Unbiased generation of neurobehavioral theories (discovering governing equations) using AI-generated dynamical and statistical models;
- Computational strategies for human neuroscience that reduce model bias towards underrepresented groups and improve data coverage, access, equity, and fairness;
- 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,

applied to the nervous system;

- Multi-scale modeling spanning temporal and spatial scales, behavioral states, or 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);
- 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, including the role of emotion;
- 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 substance use disorders, including 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), particularly in the context of pain processing and regulation.

４．採択件数、研究開発期間及び研究開発予算等

採択件数　　：最大3件

研究開発期間　：2021年度委託研究開始日（2021年9月頃を予定）から36か月間（ただし、提案者が、本委託研究の実施に36か月間の必要がないと判断する場合は、36か月間より短い期間も提案可能である。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　：米国側予算とバランスを取り、1件当たり、各12か月間に対して、総額10百万円（税込）から総額25百万円（税込）（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　：日本と米国の両方の研究機関が必ず参加する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、フランス、イスラエルとの共同プロジェクト提案も可能です（ドイツ、スペインとの共同プロジェクト提案はできません。）。

５．提案にあたっての留意点

- 以下の２つの区分について、どちらかを選択し、その区分を提案書に記載すること。
  区分1　Research Proposals
  区分2　Data Sharing Proposals
- 研究開発の到達目標を実現するための具体的な研究開発課題を設定し、かつそれら研究開発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。
- 研究開始年度の研究開発予算については、12か月分の予算の内、委託研究開始日からその年度末までの月数分とすること。また、研究終了年度の予算については、12か月分の予算から研究開始年度に計上した月数分を引いた月数分とすること。
- 日本と米国の研究機関に加え、フランス又はイスラエルの研究機関を含む場合は、３か国の共同プロジェクトとして提案すること。また、日本と米国に加え、フランス及びイスラエルの研究機関を含む場合は、４か国の共同プロジェクトとして提案すること。日本の研究機関は、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）に、米国の研究機関は、NSF（米国）に、それぞれ必要な応募書類を提出すること。また、フランスの研究機関を含む場合は、フランスの研究機関はANRに、イスラエルの研究機関を含む場合は、イスラエルの研究機関はBSFに、それぞれ必要な応募書類を提出すること（共同プロジェクトの全ての研究機関が、それぞれ該当する機関に応募書類を提出していない場合は、当該提案は無効となり、評価の対象になりません。）。なお、機構は、日本の研究機関に対して研究資金を提供し、米国の研究機関に対しては、研究分野によりNSF、NIH又はDOEが研究資金を提供する。また、フランスの研究機関に対してはANRが、イスラエルの研究機関に対してはBSFが、それぞれ研究資金を提供する。
- 採択後、研究開発の実施過程において、日本の研究機関は、共同プロジェクトの各国の研究機関と共同して活動すること。

- 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委託研究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。
- 本委託研究の遂行過程で得られる科学的なデータがあれば、広くオープンにするのが望ましい。公開できると想定する科学的なデータの有無と、有る場合には公開計画（例：公開するデータの種類、公開先、公開方法）を提案書に記載すること。

6．運営管理

- 本委託研究開始時には、日本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ので、必ず出席し、実施計画書に基づき研究開発内容を説明すること。
- 機構における自主研究部門（脳情報通信融合研究センター（CiNet））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、日本の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。
- 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。このPI会合に必ず出席すること。

7．評価

- 採択に関する評価は、CRCNS各国が参加するJoint panel reviewで行う（詳細は応募要領を参照）。
- 機構は、本委託研究終了時に終了評価を実施する。また、本委託研究終了後に成果展開等状況調査を実施し、追跡評価を行う場合がある。これら評価は、日本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、上記以外にも本委託研究の進捗状況等を踏まえて、臨時にヒアリングを実施することがある。

参考

[1] NSF の公募情報：https://www.nsf.gov/crcns/
[2] 機構における自主研究部門（CiNet）の研究内容：https://cinet.jp
[3] NSF の CRCNS に関する受託者の情報：
https://www.nsf.gov/cise/funding/crcns_awards_all.jsp?WT.si_n=ClickedAbstractsRecentAwards&WT.si_x=1&WT.si_cs=1&WT.z_pims_id=5147&
[4] CRCNS に関する日本の受託者が実施中の研究課題：
https://www.nict.go.jp/collabo/commission/k_19401.html
https://www.nict.go.jp/collabo/commission/k_19402.html
https://www.nict.go.jp/collabo/commission/k_21701.html

※ PI: Principal Investigator