FARIA
Finnish-American Research and Innovation Accelerator

ACADEMY OF FINLAND

# Call for Participation for potential US-collaborators in the area of Adaptive AI in distributed networks:

## Looking for: Expertise in Adaptive AI in distributed networks

Experts in four different work packages:

1. WP 1. Evolutional theory expert: understanding the fundamental laws of adaptation

2. WP 2. Mathematician: understanding of spatio-temporality and ergodicity

3. WP 3. Computer scientists/data scientist: deep comprehension of AI adaptation to new conditions

4. WP 4: Computer scientists/data scientist creating new AI learning models and embrace transfer and federated learning to enhance adaptation and optimalization

# Call for Participation for potential US-collaborators:

Deadline: April 15th, 2022

The Academy of Finland has two partners in the United States: the National Science Foundation (NSF) and the National Institutes of Health (NIH). The Academy and the American funders have agreed to promote Finnish-American research collaboration in 2020–2024. Cooperation will be strengthened by funding research projects between American and Finnish parties in areas represented by the research flagships included in the Academy's Finnish Flagship Program. The collaboration between the funders follows a lead agency model, with the US-agency reviewing applications and the Academy of Finland providing additional funding for Finnish PIs, thus enlarging the overall possible budget.

To support the utilization of these opportunities the Finnish-American Research & Innovation Accelerator (FARIA) launched in collaboration with the Academy of Finland a light-weight matching and preparatory program for US and Finnish researchers – the FARIAincubator.

## FARIAincubator

The FARIAincubator is a program that encourages the creation of joint project teams and prepares them to apply for funding. The preparation is conducted via a series of four online seminars which aim to share up to date information of the joint Finnish-US calls and coaching by experienced grant writers.

### *Added value for participating researchers:*

- Reach new potential collaborators specific to your field of interest
- Qualify for joint Academy of Finland/NIH/NSF funding by partnering
- Stay up to date on funding criteria and application processes
- Increase the quality of your proposal and thereby success chances for funding

## How US-colleagues can participate:

### *1. Read the short project idea and request for US-expertise:*

Finnish researchers submitted a draft research/project idea and description of the kind of collaborator expertise they are looking for. Have a quick look if your interests and expertise are a potential match.

## *2. Get in touch with the FARIAincubator team:*

If interested, send a short email until April 15th to the program manager (Dr. Jérôme Rickmann; Jerome.rickmann@aalto.fi) indicating:

- The proposal you are potentially interested in
- A short description of how you fit the searched profile

## *3. Next steps:*

Dr. Rickmann will reach out to you and organize the "matching seminar", which essentially is a zoom-session serving the Finnish PI to present the project proposal in a bit more detail and to discuss the idea with US-colleagues.

## *4. Program participation:*

After the matching seminar participants can freely decide if they want follow the program and to continue to refine the initial ideas together. The participation is at all stages free of cost and no "hard commitment" to proposal submission is expected.

## *The program is structured as follows:*

| | | |
|---|---|---|
| Step 1 | Researcher matching seminar | April |
| Step 2 | Academy of Finland Seminar:<br>Joint calls with NSF and NIH | 28th of April |
| Step 3 | Grant writing workshop | May/June |
| Step 4 | Joint proposal development/refinement | June-August |
| Step 5 | Academy of Finland Seminar:<br>Updates on imminent calls | August** |
| Step 6 | Submission of proposals | Fall 2022** |

*** Exact dates to be confirmed, depends on the Academy's budget situation and the timing of the next joint calls.*

## Background of Initiative:

The state governments of Maine, Michigan, Minnesota, and most recently Washington and Colorado have signed Memoranda of Understanding with Finland to increase collaboration in various areas of mutual interest. Other MoUs are in preparation. Research collaboration is highlighted and encouraged in all of them.

The Finnish-American Research & Innovation Accelerator (FARIA) is a US-focused RDI-network, which integrates, aligns and supports joint and associated actions of its Finnish member higher education institutions. FARIA comprises 16 Finnish higher education institutions - representing 92 % of Finnish research universities, and 89 % of the Finnish HE sector's RDI-power (measured in RDI funding).

FARIA is financed by the Finnish Ministry of Education and Culture and collaborates closely with the Finnish Ministry of Foreign Affairs to strengthen Finnish-US RDI-relationships.

FARIA is jointly coordinated by Aalto University and the University of Helsinki.

www.faria.network

USA - Academy of Finland (aka.fi)

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# Proposal:

Consent: By submitting the form you consent that we share the here compiled information with academic institutions in the USA in order to find suitable colleagues for your idea.

## Your research project idea?


**Abstract**

The aim of this project is to study "Nature of Adaptive Algorithms" based on the law of physics (Greek: φύσις, **fysis, nature)** to better understand human-nature interaction and an adoptive nature of process, where the Gaussian proposal distribution is updated along the process using the full information cumulated so far. An adaptive Metropolis algorithm has the correct ergodic properties. In mathematics ergodicity expresses the idea that a point of a moving system, either a dynamic system or stochastic process will eventually visit all parts of the space that the system moves in, in a uniform an random sense. A stronger concept than ergodicity is that of mixing, which aims to mathematically describe the common-sense notions of mixing, such as mixing drinks or mixing cooking ingredients.

There is a wide spectrum of artificial intelligence algorithms which belongs to different class of approaches (conservative/modern), including fuzzy logic, expert systems, evolutionary strategies and genetic programming. (Russell & Norvig 1995). However, there are also differences between different paradigms in natural sciences and these differences mean that there are different paradigmatic underpinnings for modelling artificial intelligence algorithms that determine the key assumptions of information, ontology of organizing and ontology of modelling spacetime.

One of the fastest-growing sub-fields of computational intelligence is evolutionary computation. In this field, there are many algorithms to solve optimization problems. These algorithms mimic and simulate the Darwinian theory of survival of the fittest in nature (Reynolds 1987). Such algorithms mostly mimic biological evolution in nature (Mirjalili et. al. 2019). In other words, they use genealogical information of population adaptation to environment. This means that evolutionary algorithms (EA) search only a part of search space using heuristics information, but instead utilize adaptation of population.

Paradigm for modelling theory of evolution based on genealogical data produces evolutionary algorithms that are equipped with several random (stochastic) components, which select and combine solutions in each population. They model the theory of evolution based on genealogical data. This makes them unreliable in finding similar solution in each run as opposed to deterministic algorithms. Deterministic algorithms (e.g. brute force search) find the same solution in every run, but suffer from slower speed and local solution stagnation when applied to large-scale problems (Mirjalili et. al. 2019).

The project demonstrates potential innovations that will substantially advance in science at a global level. Our theoretical goals are to a) WP 1. understand the fundamental laws of adaptation, b) WP 2. understanding of spatiotemporality and ergodicity c) WP 3. deep comprehension of adaptation to new conditions and d) WP 4. creating new AI learning models and embrace transfer and federated learning to enhance adaptation and optimalization.

The main research question is, how AI algorithms adapt to new conditions?

Data from the nature will be collected by project pilots using off-the-shelf nature storage and transmission equipment. As a result of the project, we will have a better understanding of the interaction between man and nature and the effects of man on nature and its sustainable development.

The project is new era of informatics and extremely significant for AI researchers (de Bézenac E, Pajot, A. & Gallinari, P. (2019). Modelling physical phenomena based on laws of physics is paradigm shift towards nature-based AI. The project elaborates adaptive algorithm based on law of physics. The equality,

transparency, trust, and security are identified as ethical factors that are essential, when developing self-organising adaptive AI systems.

KEYWORDS
Artificial intelligence algorithms, Adaptation, AI paradigms, Assumption of information, Modelling paradigms, Modelling spacetime

REFERENCES

de Bézenac E, Pajot, A. & Gallinari, P. (2019). Deep Learning for Physical Processes: Incorporating Prior Scientific Knowledge. Journal of Statistics.
Mirjalili , S., Song Dong , J. Ali Safa, S. & Hossam, F. (2019). Genetic Algorithm: Theory, Literature Review, and Application in Image Reconstruction, Nature-Inspired Optimizers pp 69-85
Russell, P. & Norvig, P. (1995). Artificial intelligence – a modern approach. Eglewood Cliffs, NJ.
Reynolds, C. W. (1987, August). Flocks, herds and schools: A distributed behavioral model. In ACM SIGGRAPH computer graphics (Vol. 21, No. 4, pp. 25-34). ACM.

## How does your idea relate broadly to the flagship areas: AI, wireless technology 5G/6G, materials bioeconomy or inequalities/interventions/public social support systems?

The projects WP contributes do following flagship areas:

WP 1. Understand the fundamental laws of adaptation

The future of connectivity is in the creation of digital twin worlds that are a true representation of the physical and biological worlds at every spatial and time instant, unifying our experience across these physical, biological, and digital worlds.

WP 2. Understanding of spatiotemporality and ergodicity

The use of AI/ML in the RAN, AI/ML will become essential for the 5G end-to-end network automation dealing with the complexity of orchestration across multiple network domains and layers. This will allow for dynamic adaptation of network and cloud resources according to changing demands, rapid deployment of new services and fast mitigation of failures, while significantly reducing operational expenditures.

WP 3. Deep comprehension of adaptation to new conditions

The network will be engineered with distributed AI/ML techniques embedded in various nodes, and how quickly they adapt to new conditions in the network is an important measure. Network automation will be the norm, and thus how close a network is to complete automation with zero manual intervention will be another criterion.

WP 4. creating new AI learning models and embrace transfer and federated learning to enhance adaptation and optimalization

Moving from AI for 5G to AI for 6G, we expect that various forms of learning will be employed to realize the future applications. Transfer learning and federated learning will play critical roles. Systems will have to be trained offline in simulation environments to a sufficient extent first so that basic communications can be established, and then be subsequently trained in the field to optimize performance.

So there will be transfer of learning from the simulation to the field environment. Devices and network infrastructure have to co-learn to incorporate end-to-end operations, and here, federated learning will play a role. Rather than sharing large data sets between various devices and the network, models will be shared. At the higher layers, deep reinforcement learning will be necessary for optimization of resource allocation and control of various parameters. Hierarchical and multi-agent reinforcement learning will need to be used across different nodes.

In addition, we can also expect some other use cases such as localization of end devices using 5G technology to exploit learning techniques for improved accuracy.

## What (complementary) expertise are you looking for from US-partner?

Expertise in Adaptive AI in in distributed networks: Experts in four different work packages.

1. WP 1. Evolutional theory expert: understanding the fundamental laws of adaptation
2. WP 2. Mathematician: understanding of spatiotemporality and ergodicity
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## Which information you want the US-colleague to have about your expertise/background?

**Interaction Director /Curriculum Vitae**

1. **Personal details and the date of the CV**
   - Laakkonen Mika-Petri
   - https://orcid.org/0000-0003-3230-7958
   - 12th January 2022
2. **Degrees**
   - PhD (Information technology), 17th, January 2007, University of Lapland, Finland, contact details +35816341341
   - Licentiate of Education (Cognitive Science). 28th January 2002, University of Lapland
   - Master Degree of Education (Educational Sciences), 30th, May 1995, University of Lapland
3. **Other education and expertise**
   - Matriculation exam, 30th May 1989, Upper level secondary school, Oulainen, Finland, Matriculation exam, High School, 30th May 1988, Lexington, USA,
4. **Language skills**
   - Finnish, English (C2), Swedish (C2), French (C2), German (B2)
5. **Current employment**
   - January 1st 2020 – December 31st 2021, Research Director, University of Lapland, Rovaniemi, Finland
6. **Previous work experience (recent 2018 - 2021)**

- September 1st, 2018 – December 31st, 2019, Visiting professor, Université de la Sorbonne, Pierre et Marie Curie Université, Paris, France
- March 1st, 2019 – April 30th, 2019, Visiting associate professor Versailles Saint-Quentin-en-Yvelines University, Paris, France
- July 1st – August 31st, 2018, Research Director, University of Lapland, Rovaniemi, Finland
- January 1st to June 31st, 2018, Associate professor of Applied Information Technology, University of Lapland, Rovaniemi, Finland

**7. Personal funding and grants (recent 2018 – 2021)**

- PI (Principal Investigator), March 22nd, 2019 – January 31st, 2022, French Ministry of Higher Education, Research and Innovation, Finnish Academy of Sciences Finnish Science Association, Maupertuis 2020 OPEN: France-Finland bilateral funding program for scientific cooperation, Fund € 3000
- PI (Principal Investigator), July 1st 2021– December 31st 2021, Provincial Voluntary Development Funding (AKKE), Digital Aviation Fund € 77 809
- PI (Principal Investigator), September 1st 2018 – December 31st, 2019 Design in Smart Mobility Business Services, Business Finland Ltd., Fund € 438 000
- Member of the project preparation working group, September 1st 2018 – October 31st 2021, Arctic Smartness RDI - Excellence (ASR), ELY centre, Fund € 655 656
- Project developer and researcher, September 1st 2018 – December 31st 2021, ERDF, Future Bio-Arctic Design - Organic Smart Textile (F.BAD), Fund € 496 581
- PI (Principal Investigator), InterregEurope, September 1st 2018 – December 31st 2021, RegionArts: "Enhancing SME growth by the integration of Artist in ICT projects Fund € 1 776 120
- Project developer, September 1st 2018 – December 31st 2021, Prosoc (Arctic Societies Vocational Research Group), Fund € 450 000 €

**8. Research output**

- Total number of publications (first or second writer): 33 (22 peer-reviewed). For the most important publications for the research project, see the included appendix. For a list of all research output, see my profile at https://orcid.org/0000-0003-3230-7958

**9. Research supervision and leadership experience**

- Supervisor of over 150 theses
- Two doctoral students started (2021)

**10. Teaching merits**

- University Teacher since 1998 in artificial intelligence (deep learning), computer sciences, HCI (human-computer interaction) and future research methodology.
- Keynote speaker in numerous international conferences at Berkeley University, Fudan University, University of Helsinki, Oxford University, Technical University of Arkhangelsk, University of Florence and Sorbonne University

**11. Other key academic merits, scientific and societal impacts (2018 – 2022)**

- Currently (2022-) I am member of FCAI (Finnish Center for Artificial Intelligence) community, which brings together of top talents in academia, industry and the public sector to solve real-life problems using both exiting and novel AI. FCAI is one of the Academy of Finland's Finnish flagships, hubs of top level-research and impact.

- 2021 – Member of Finnish-American Research and innovation Acceletors FARIA strategic network. The main goal of the network is to carry out collaborative projects aimed at cutting-edge research and innovation together with American partners in artificial intelligence
- 2019 - European Commission's Directorate-General for CONNECT (Communications Networks, Content and Technology), independent expert, the Horizon 2020 flagship Artificial Intelligence project, funded by the European Commission, looking particularly at predictive algorithms related to health technologies.
- Editor-in Chief: Topic of Special Issue is: “Artificial Intelligence (AI) in contemporary society” (jufo 2)
- 2019 Society for Futures Studies (2019) referee, Malaska Award, (Graduation Award),
- 2018 National Audit Group of the Finnish Universities (2018), evaluator of the quality of research at the University of the Arts and IAMCR (International Association for Media and Communication Research) conference reviewer

**List of ten most important publications (related to the topic of the project)**

1. Laakkonen, M., Kivivirta, V. & Mazari, A. (2022). Four modelling paradigms for artificial intelligence algorithms, Philosophy of Science (evaluation phase/jufo 3)
2. Laakkonen, M. & Kivivirta, V. (2022). Elevators as media object: Manipulating information in time, New Media & Society: SAGE Journals (jufo 3)
3. Laakkonen, M. 2021. Artificial Intelligence (AI): Hidden Rules of our Society, Artificial Intelligence in our contemporary society. Special Issue of Journal of Administrative Studies" (jufo 2)
4. Laakkonen, M. (2021). Information, ethics, and the digital society (ed.) SoPhi (Publisher) (jufo 1)
5. Kivivirta, V. Laakkonen, M-P., Myllykoski, J. & Rantakari A. (2021) Predictive algorithms in MNC: Whiteheadian process ontological view of prediction, 37th EGOS Colloquium 2021, University Amsterdam, The Netherlands (peer-reviewed)
6. Kivivirta, V & Laakkonen, M-P. (2020). Thinking organizing with Whitehead in the age of predictive algorithms, Organizations, Artifacts, and Practices (OAP) Workshop 2020, University of California, Berkeley (peer-reviewed)
7. Kotilainen, S., Laakkonen, M-P. & Okkonen, J. (2018). Children's trust in artificial intelligent applications: Needs for media literacy 3.0", to the Media Education Research Section for IAMCR 2018 - Oregon. June 20 – 24, 2018. (peer-reviewed)
8. Laakkonen, M. (2018). Cognitive stages in rational thinking - towards human technology. Electronic Imaging & the Visual Arts, EVA (2018) Florence, conference, May 9 – 10th, 2018. (peer-reviewed)
9. Keinänen, J & Laakkonen, M. (2012). Virtual Tutor: Designing a Teaching Model for a Programmed Guide, AACE Association for the Advancement of Computing in Education, November 6 – 8, 2012 (jufo 2)
10. Laakkonen, M. 2003. The Future Relationship Between Virtual Reality and Human body, The Good, The Bad and The Irrelevant Conference, User and the Future of information and communication technologies, 2003 September 3rd – 5th, Helsinki, Finland (peer-reviewed/nominated for the best paper in conference)

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## Your contact details:

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Note on eligibility: In addition to a doctoral degree, the PI of the proposed project must also have other significant scientific merits. Usually, the PI is a researcher at the professor or docent (adjunct professor) level. In addition, the applicant must have a close connection with Finland to support the implementation of a multi-year project.

**Please send form by March 14th, 2022 to Jerome.rickmann@aalto.fi**