Copy of the Call 2018 ACAI Topic Suggestion

In the framework of the open consultation to collect research topics for future CHIST-ERA calls, this document offers an example of past-suggested topic. It illustrates the type of content that can support promoting the topic.
The chosen example is the description of the topic Analog Computing for Artificial Intelligence (ACAI) *proposed in 2017 in view of the Call 2018.*

Topic definition

Topic title *(2-10 words)*	Analog computing for Artificial Intelligence
Short description *(30-100 words)*	Analog computing, which was initially the mainstream approach in computing, has seen its progress outpaced by the huge investments in digital computing following Moore's law during almost five decades. However, with the end of Moore's law, there is room again for more varied computer architectures including analog ones. These can enable fast, energy-efficient computing for specific applications and thus become attractive again. Furthermore, the field of Artificial Intelligence, which is progressing fast, addresses signals which are intrinsically analog (image, sound, speech, proprioception, etc…) and increasingly relies on neural networks which naturally lend themselves to analog computing. In this context, analog computing becomes appealing for running Artificial Intelligence applications locally on personal devices, and more generally in an energy-efficient way.
Application sectors	All application sectors of Artificial Intelligence, especially in portable or autonomous devices
Keywords	Analog computing, Artificial Intelligence, neural networks, neuromorphic, low-power ICT, resource-efficient ICT

Selection criteria grid

Please provide based on the CHIST-ERA topic selection criteria grid, for each criteria a rationale of between 2-20 sentences

Criteria	Description
Scientific interest and innovation potential *(Required for funding organisations, Scientific Advisory Board and general public)*	
Novelty & ambition	*Describe the state-of-the-art, missing science, and expected outcomes (the topic should be far from existing knowledge and technology), and analyse potential S&T issues (the topic should be plausible)*
	Analog computing is receiving renewed interest. This can be understood in the context of the end of Moore's law, which has been driven by CMOS scaling for almost half a century but is reaching physical limits. In this context, application-specific architectures become more attractive, and after a move towards parallel architectures (multi-core, GPUs), analog architectures can be expected to be a new frontier as they can offer fast, energy-efficient computing for some applications. For example, analog VLSI chips have been launched on the market in 2015 for differential equation applications. Artificial Intelligence applications are good candidates for exploiting the possibilities offered by analog computing. Indeed, they can easily tolerate approximate computations, neural networks are suitable for analog implementations, and there is a strong need for green (low-power) AI systems. This has been acknowledged in a series of articles since 2016. The topic is thus highly novel while also being highly plausible. The topic is also highly ambitious. Analog neuromorphic hardware is still in its infancy and has not yet reached the point where it outperforms GPUs for AI applications. Missing science includes how to design analog computers and in particular neural network architectures which offer the same capabilities as the highly optimised GPUs while being more energy-efficient for some real AI tasks.
Multidisciplinary and/or transformative	*Describe how knowledge and communities from different disciplines can be brought together to investigate unknown fields at the frontier of science and/or how the topic can be a game changer with a high scientific and technological impact*
	A challenge is to combine research on AI systems, which are currently implemented on general-purpose hardware, with research on analog computing. Analog computing, being non-Turing, can open the way to completely new techniques for AI systems. Conversely, the AI field, which is expanding quickly, can offer many prospects for analog computing.
Clarity and measurability	*Describe how well defined the topic is and how scientific and technological performance can be objectively measured in the area (measurement methods, metrics, tools, infrastructures, …)*
	The topic can be clearly defined as expanding the capabilities of AI systems by exploiting the possibilities offered by analog computing. Measurability can be developed from existing AI system performance benchmarks, energy consumption metrics and computation time.

Criteria	Description
Timeliness	*Describe which opportunities might be lost if the topic is not funded*
	With the need for AI for many applications and the end of Moore's law, the topic is timely. Energy consumption becomes a bottleneck and radically new low-power implementations are needed to make AI applications sustainable especially in the context of edge computing.
Potential impact	*Describe the potential impact on future EU economy, environment and/or society, and analyse risks (social acceptance, legal issues, ...)*
	Fast and energy-efficient implementations of AI applications can make them much more successful in many environments, especially on mobile devices. By binding information with the hardware, analog architectures also make systems less prone to cloning and to information security attacks.
Suitability for a CHIST-ERA call *(Required for funding organisations, optional for Scientific Advisory Board and general public)*	
Need for transnational cooperation	*Describe how transnational cooperation in the framework of a joint call can bring added value (complementary national scientific strengths, need for critical mass, need for joint infrastructures, ...)*
	There is a need for transnational cooperation to gather critical mass and take advantage of complementarities at the European level.
Complementarity with existing calls	*Describe closest calls (FET, H2020, ERA-NETs, ...) and how the topic complements and/or leverages them (the topic should not be redundant with other calls)*
	The closest call in the H2020 WP2018-2020 is the one on "Unconventional Nanoelectronics" (ICT-06-2019, 30 M€, expected project size of 2-4 M€, deadline 29.03.2019). It covers energy-efficient computation devices and circuit architectures but has a much wider scope. It is also hardware-oriented and does not focus on any application domain. If a project selected in that framework is selected, it could be invited to the CHIST-ERA Projects Seminars. Besides, the FET programme includes a call for a CSA on "Community building in Neuromorphic Computing Technologies" (FETPROACT-02-2018, 0.5 M€, deadline 22.03.2018). Synergies can also be expected with this potential CSA.
Suitability of topic size	*Describe how a significant contribution in the area can be obtained with a call of funding 8-10 projects of 0.8-1.0 M€ each, possibly giving indications about the size of the main events, initiatives or structures in the area (conferences, programmes, teams, centres, professional associations ...).*
	Combining AI with analog computing is highly novel. A few projects can thus make a significant difference for the topic.

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Provide bibliographical references and/or web links

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