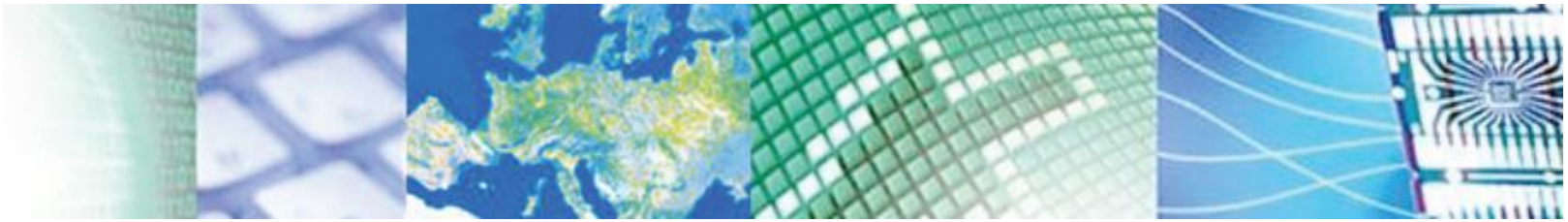

CHIST-ERA Projects Seminar 2022
Analog Computing for Artificial Intelligence (ACAI)

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Introduction: Projects of ACAI

JEDAI - Event Driven Artificial Intelligence Hardware for Biomedical Sensors

AIR - Analogue Intelligent chip for short and middle range Radar signal processing

SMALL - Spiking Memristive Architectures for Learning to Learn

APROVIS3D - Analog PROcessing of bioinspired Vision Sensors for 3D reconstruction

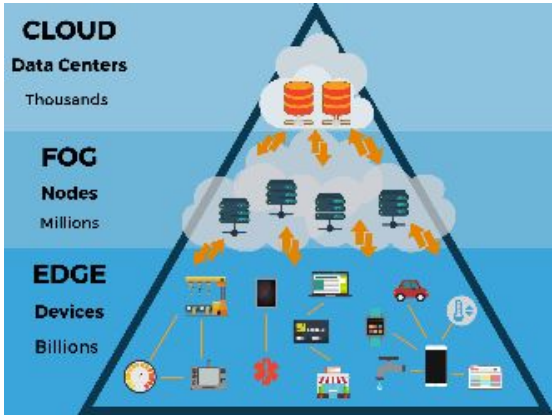
UNICO - Unsupervised spiking neural networks with analog memristive devices for edge computing

Introduction: Projects of ACAI

All ACAI projects are focusing on Edge Computing applications

MOTIVATION

- Energy consumption
- Embedded/integrated devices
- Intelligent computing



UNIFYING ELEMENTS

- Learning / adaptivity
- Different input modalities / different processing architectures
- Various flavor of Event-based / Analog representation

Technology:

- SpiNNaker (many cores)
- Custom CMOS chips
- Custom hybrid CMOS / memristive technologies

Introduction: Projects of ACAI

Application domains

- ✔ Health monitoring (JEDAI, AIR)
- ✔ Edge AI (SMALL, AIR, JEDAI, UNICO)
- ✔ Autonomous navigation (APROVIS3D)
- ✔ Pattern recognition (UNICO, APROVIS3D, JEDAI)
- ✔ Surveillance (AIR, APROVIS3D)
- ✔ Robotics (SMALL)

Major Achievements and Outputs

Major outputs

- ✔ Algorithms for training spiking networks
- ✔ Analog HW-friendly algorithms
- ✔ Spiking Chip with learning capabilities
- ✔ New signal processing architectures
- ✔ Creation of new datasets (ECG/ICG, ToF sensors, DVS, radar) - open access

Major Achievements and Outputs

38 publications:

Journals: Adv. Elect. Mat., TBioCAS, IEEE TNNLS, eLife,...

Conferences: NEURIPS, ICONS, ISSCC, ISCAS, AICAS...

3 (+2 pending) Chips manufactured / 2 (+1) embedded platforms

Upcoming Challenges and Needs

Long-Term Vision

- ✔ Learning in spiking neural networks
- ✔ Enabling event-based signal processing
- ✔ Increasing density and robustness of non-volatile memories
- ✔ Real-life demonstrations of analog computing

Research methods and needs

- ✔ Complementary expertise of interdisciplinary groups
- ✔ Focus on cooperation not competition
- ✔ Long-term ambitious research programs
- ✔ Industry involvement
- ✔ Schedule (delays due to pandemic)
  - 3 already requested + 2 plan to request for extension
- ✔ System-level integration (final demonstrator)
- ✔ Unifying the neuromorphic community / interdisciplinarity
- ✔ Standardization (datasets, data representation)
- ✔ Benchmarking / fair comparison / metrics

Possible Roadmap

- Proof of concept with physical demonstrators on dedicate application
  - Further supports are required towards emerging architectures

- ACAI address only some aspect of Edge devices
  - Diversification should be sustained

- Follow-up projects
  - EIC transition
  - Suggestion: revisiting of ACAI topic by future CHIST-ERA calls

- In-person workshops, seminars,... for the community

Role of the CHIST-ERA Support

- Selection of interesting topics and guiding national funding agencies
- Opportunity for young researchers to work on ambitious projects
- Facilitating transnational collaborations
- Networking opportunities
- Extend the Chist-Era website to incorporate individual project website into a common one (links to results, papers, news,...)

++ very limited bureaucracy :-) !

-- coordination CHIST-ERA <-> national agencies to avoid double applications (also for project extensions)

Responsible Research & Innovation

- Examples of good practices:
  - ✔ Open Access publications
  - ✔ Scientific talks (Open Science, Science education)
  - ✔ Sharing datasets in public repositories

- Major hurdles:
  - ✔ Huge effort to make data FAIR-compatible
  - ✔ Communication with broader audience to raise the awareness and trust
  - ✔ Adapting the scientific content to a general audience necessitates dedicated resources and competencies

Open Science

- ✔ Open Access publications
- ✔ Scientific talks (Open Science, Science education)
- ✔ Sharing datasets with documentation in public repositories

Recommendation in the call text to account in the budgets for the effort to make data FAIR-compatible

Technology Transfer

Because of the low maturity, transfer to companies is difficult

Hardware is generic and scalable (large companies) vs SME "niche applications" → to be addressed

Reluctance of industry to openly share the know-how, data, and other results - OS vs IPR

ACTIONS:

- **Patents**
- **Massively open source**
- **Contributing knowledge to marketable products**
- **University spinoff (Arc Instruments)**

Questions

Questions ?