Panel: Humans vs. Things in the Metaverse

Chair: Jamil Kawa, Synopsys

Panelists:
David Atienza, EPFL
Tajana Siminic, UCSD
Joseph Friedman, UT Dallas
Victor Grimblatt, Synopsys

Summary: The metaverse has dramatically evolved since the term was coined back in 1992 by Neal Stephenson in his science fiction novel “Snow Crash”. It progressed from representing the Internet of Things to the Internet of Everything “IoE”, to a virtual world that encompasses augmented reality (AR), virtual reality (VR), 3D holographic avatars, and is moving along to include “smart objects”! It is considered by some to be the nucleus to a parallel universe. In this panel we’ll address the metaverse from an engineering and science perspective addressing issues related to the inclusion of actors beyond humans such as “smart objects”, we’ll address the potential of the metaverse to be an interconnected multiverse serving different applications, with different populations. We’ll also lookat the possible evolution venues of the metaverse in the presence of AI and the security, safety and governance implications associated with that.

David Atienza

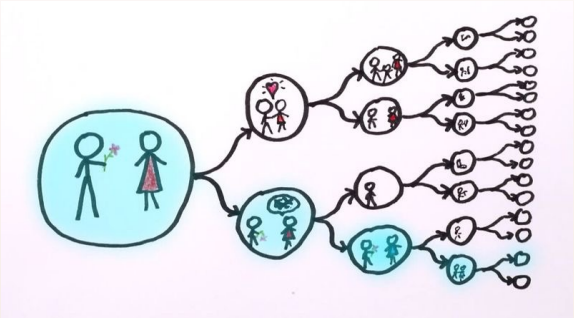
EPFL

Humans vs. Things in the Metaverse

Metaverse Concept… Just one Thing?

- Metaverse in all dimensions: "… massively scaled and interoperable network of real-time rendered 3D objects" (M. Ball – 2020, video gaming)
  - Persistent virtual world for **humans and objects** to interact and solve a problem **together**

- Long run: hard to create a "single" Metaverse/twin for all: one size does not fit all…
  - **Multiverse**: "confusing moral meaning of natural phenomena and not to other possible universes" (W. James – 1895, Philosophy)
    - Multiple applications, multiple tastes, etc. You can choose… but someone has to "regulate" it!

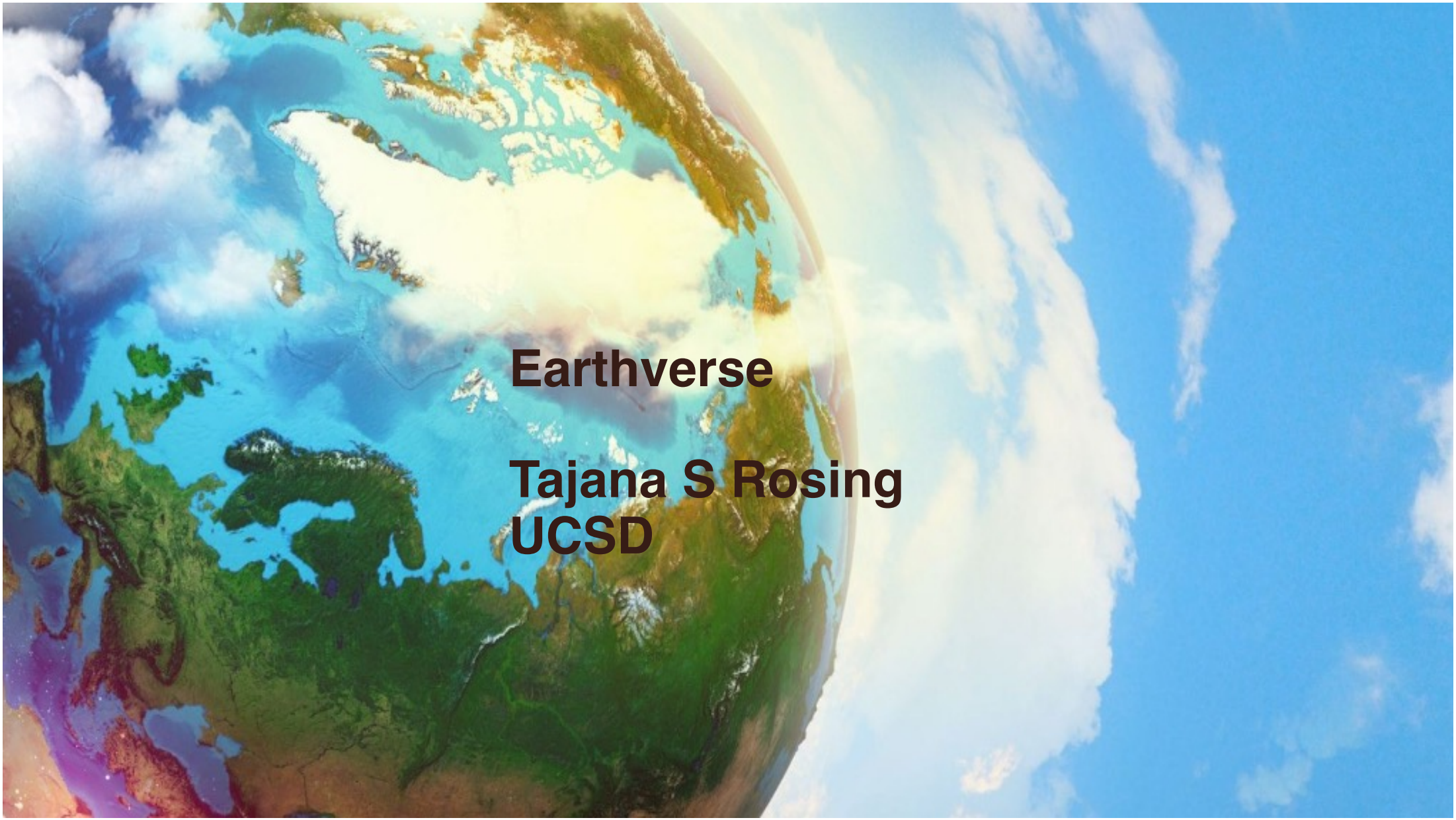


[Ack. Encyclopedia Britannica]

Metaverse and Privacy?

- Multiple modalities of edge AI devices to enable the metaverse: Next-gen IoT and Cloud interaction
  - Sustainable with current electronics and AI?
    Not really: **“biodegradable” IoT, “zero-energy” AI, …**
  - Energy for it? Much worse than IoT: more objects, harder real-time interaction constraints: **Multi-level/hierarchical concept**

- Full knowledge of people’s world/actions to create it
  - Impossible to preserve “privacy”, **rethink fundamentals?!**
  - Ethical/Moral consequences: How do we get **“universal rules” in the Metaverse**… We do not even agree in our real world!


Earthverse
Tajana S Rosing
UCSD

Evolution of wireless, bigdata, machine learning and deep learning

1G

Voice only services

2G, 2.5G, 2.75G

Voice, Data ad web mobile internet, low speed streaming services and email services

3G, 3.5G

Voice, Data, Multimedia, support for smart phone applications, fast web, video calls and TV streaming

4G

High speed, high quality voice over IP, HD multimaedia streaming, 3D gamming, HD video conferencing and worldwide roaming

5G

Super fast mobile internet, low latency network for mission critical applications, IoT, security ad surveillance, HD multimedia, autonomous driving, shmart healthcare

6G

1950	1990	2005	2010	2020 and beyond	....

BigData

RDBMS, data warehousing, online analytical processing, dashboards and scorecards, data mining and statistical analysis

Opinion mining, unstructured data, question answering, web analytics and web intelligence, social media analytics, social network analysis, special-temporal analysis

Location aware analysis, person-centralized analysis, context-relevant analysis, mobile virtualization, human-computer-interactions, antonomus decisioning

AI & ML

Model for biology neurons, perceptons, back propagation model, multilayer neural networks, 8 layer deep network, RNN, ANN, back propagation CNN, stochastic requirements, CNN using back propagation.

ML and AI take separate paths

Work from ML shifts from knowledge-base to data-driven approach, vaishing gradient problem, LSTM, Deep belief network, ImageNet

Vanishing gradient, DeepLearning boom, Generative Adversarial NN, AlphaGO beats human, Trio wins Turing award, Deep Face

ChatGPT

Metaverse Today

"*Horizon Worlds*" was quickly dismissed as a poor quality video game despite Zuckerberg's insistence that it was more.

The New York Times

Mass Layoffs and Absentee Bosses Create a Morale Crisis at Meta

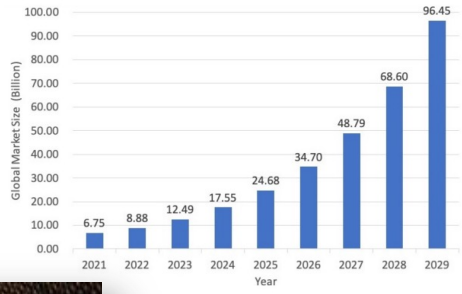
By Sheera Frenkel and Mike Isaac
Reporting from San Francisco

April 12, 2023

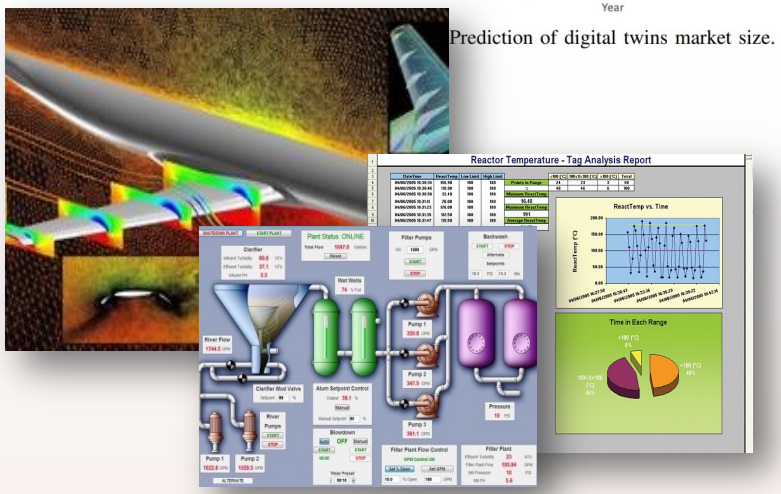
Meta's "year of efficiency" means job cuts less metaverse, and more generative AI

Mark Zuckerberg is shifting the company's focus to language models for AI

Where digital meets physical with success



Prediction of digital twins market size.

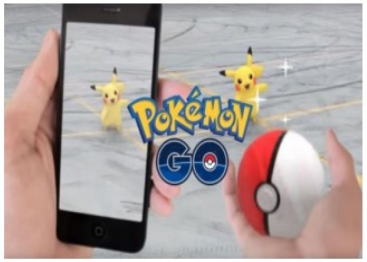


Virtual Reality (VR)

VR games

Virtual training on driving a excavator

Augmented Reality (AR)



Pokemon Go

IKEA smartphone AR app

Mixed Reality (MR)

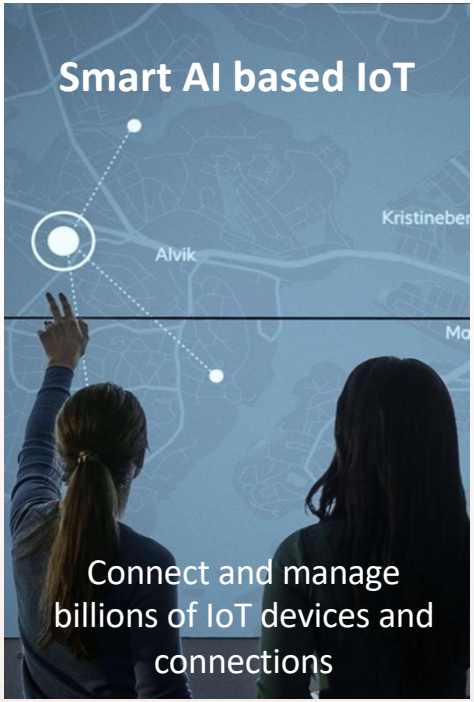
Airbus production line

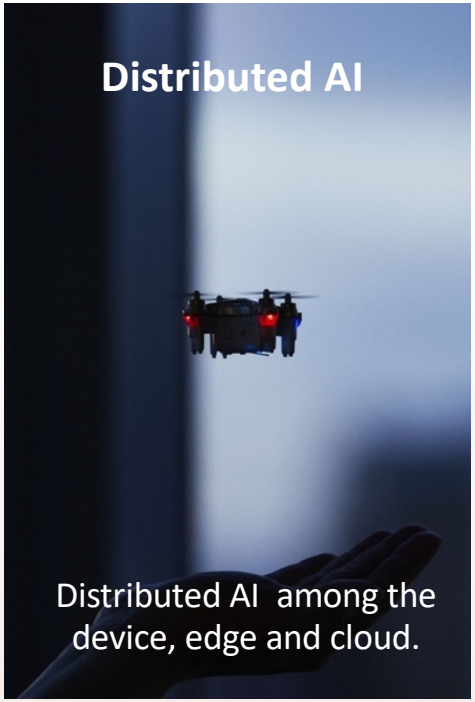
Volvo Automotive

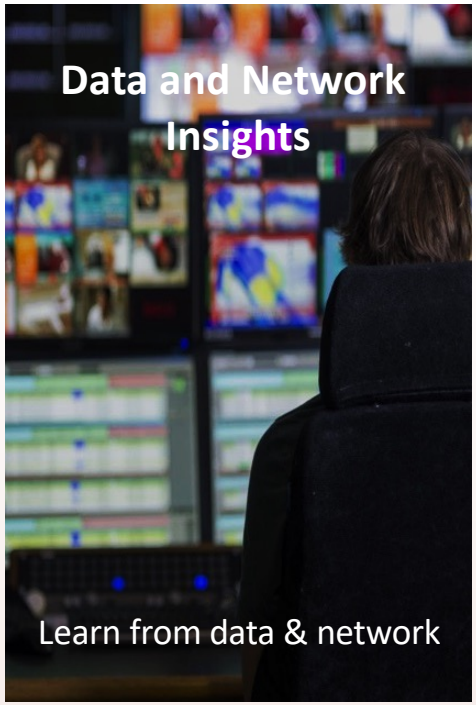
Digital twins

- show current and historical sensor status
- enable development of models to virtually test how something that might not exist will react in a specific environment
- merge data collected by IoT sensors with physics to optimize system design, predictive maintenance and asset management

IoT supercharged by 6G & AI → Eart







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ChatGPT

Joseph Friedman

UT Dallas

Humans vs. Things in the Metaverse

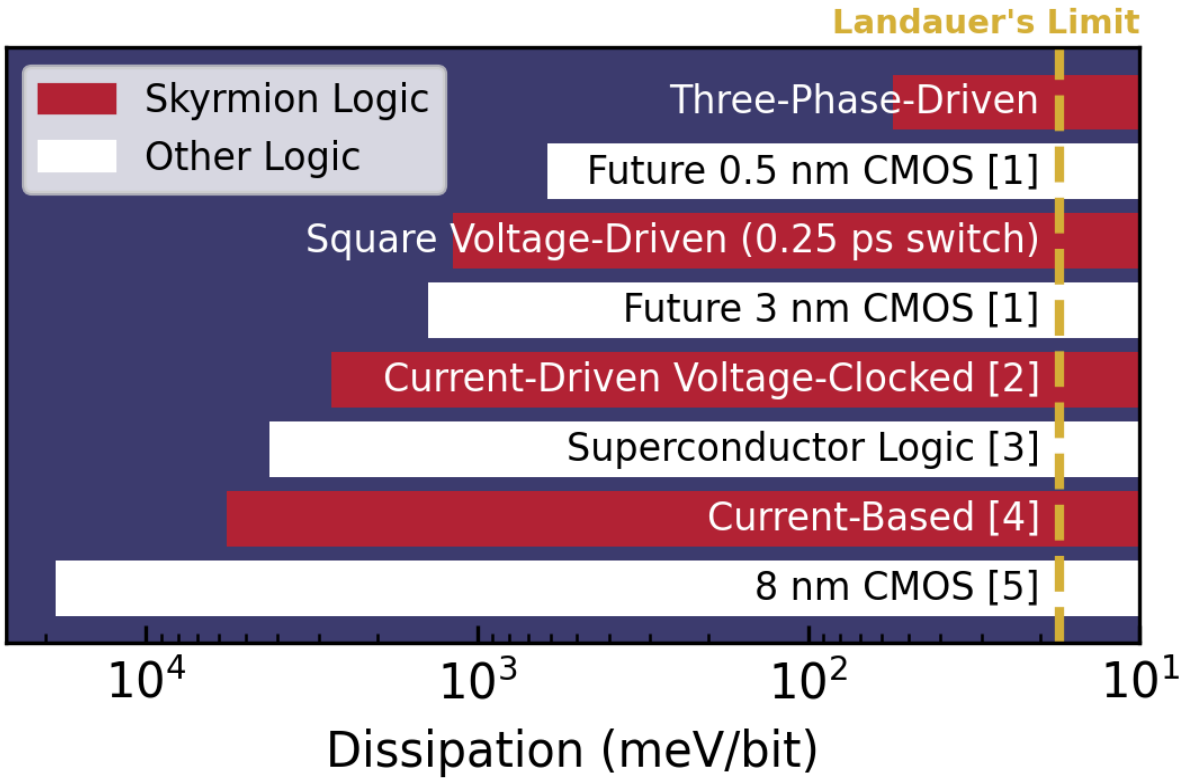
Humans vs. Spintronics on the Metaverse

- Edge Computing
  - Extreme energy efficiency
  - Robustness to intermittent power cycling
- Inference with Pre-Trained Models
  - Extreme energy efficiency
  - Everything else can be sacrificed
- Online Learning & Inference
  - Backpropagation uses too much energy
  - Unlabeled data unavailable

Edge Computing: Reversible Computing with Magnetic Skyrmions

B. W. Walker, A. J. Edwards, X. Hu, M. P. Frank, F. Garcia-Sanchez, **J. S. Friedman**, a*rXiv*, 2023

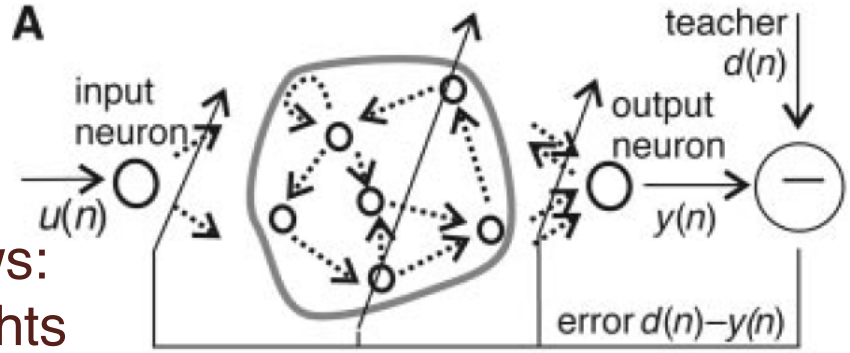
Edge Computing: Reversible Computing with Magnetic Skyrmions



B. W. Walker, A. J. Edwards, X. Hu, M. P. Frank, F. Garcia-Sanchez, **J. S. Friedman**, a*rXiv*, 2023

Inference with Pre-Trained Models: Nanomagnet Reservoir Computing

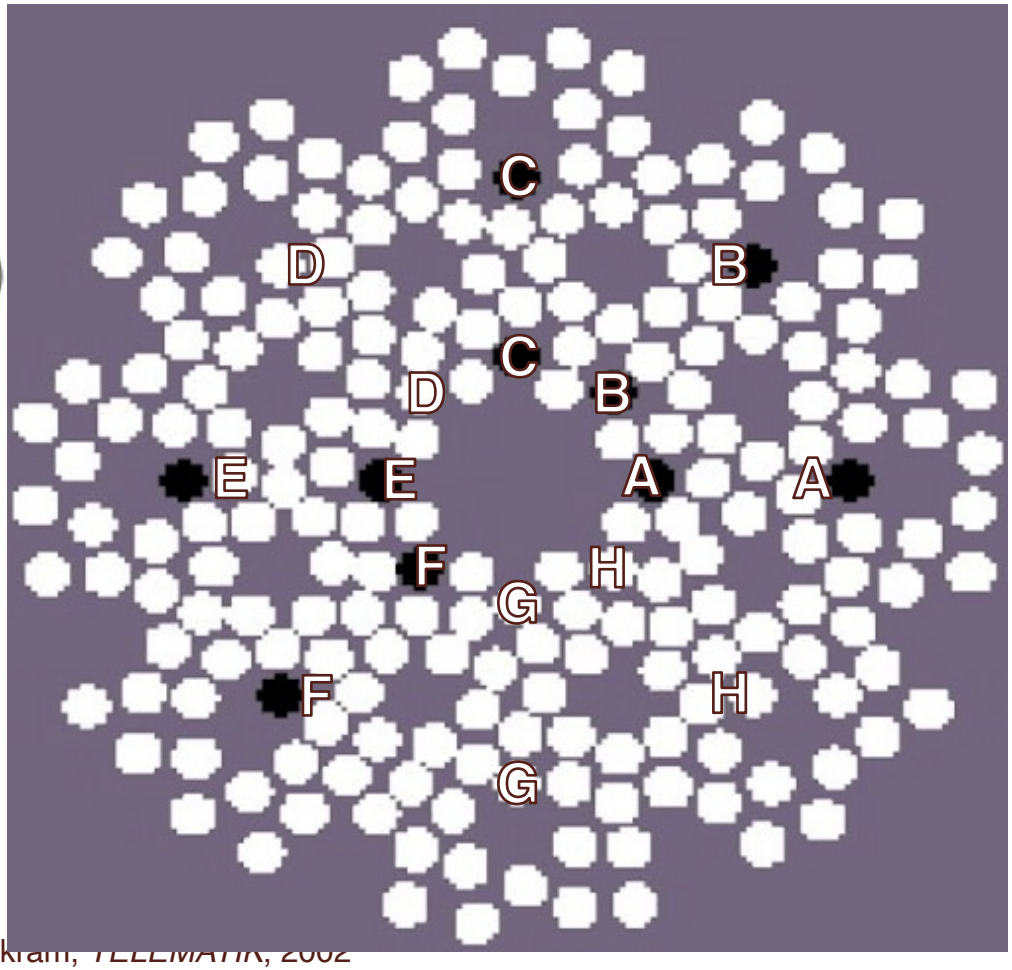
Recurrent Neural Network



Dotted Arrows:
Trained Weights

Reservoir Cc

Solid Arrows:
Fixed Weights

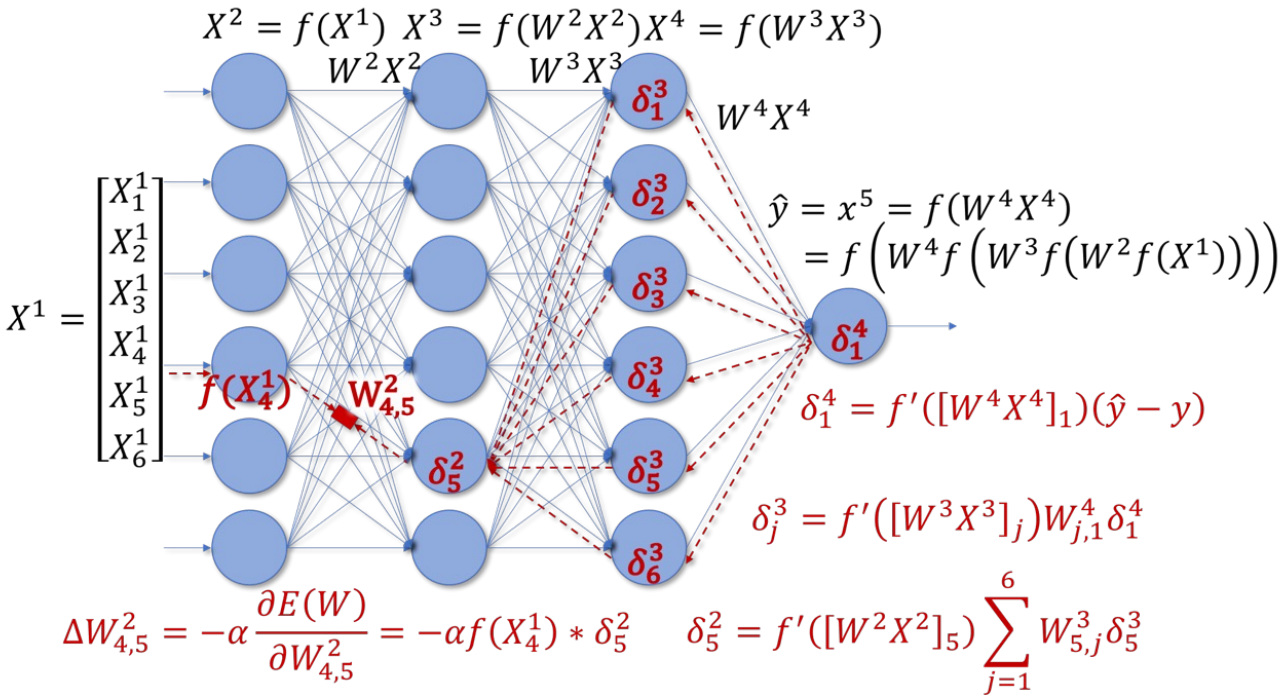


T. Natschläger, W. Maass, H. Markram, *TELEMATIK*, 2002

A. J. Edwards, D. Bhattacharya, P. Zhou, N. R. McDonald, H. Hasan, C. D. Thiem, J. Atulasimha, **J. S. Friedman**, *arXiv*, 2022

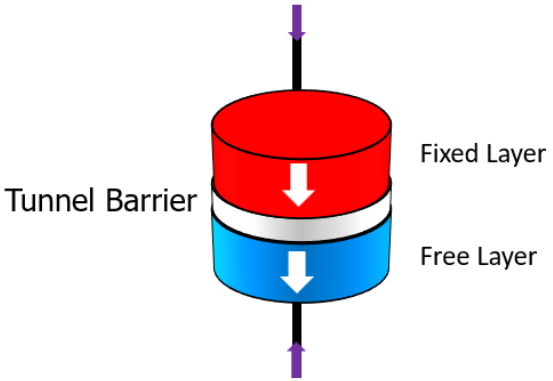
H. Jaeger, H. Haas, *Science*, 2004

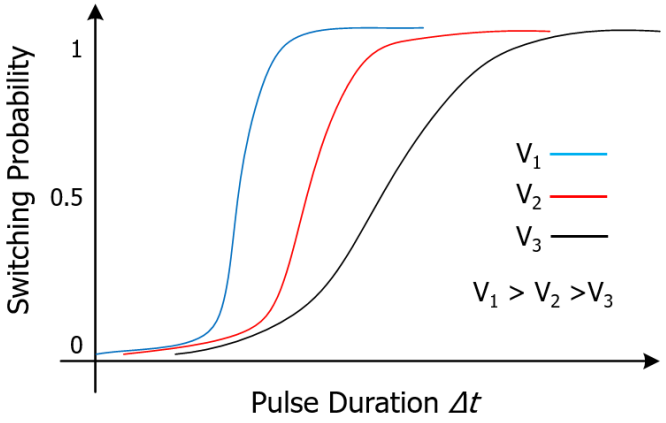
Online Learning & Inference: Unsupervised Stochastic STT-MRAM Switching

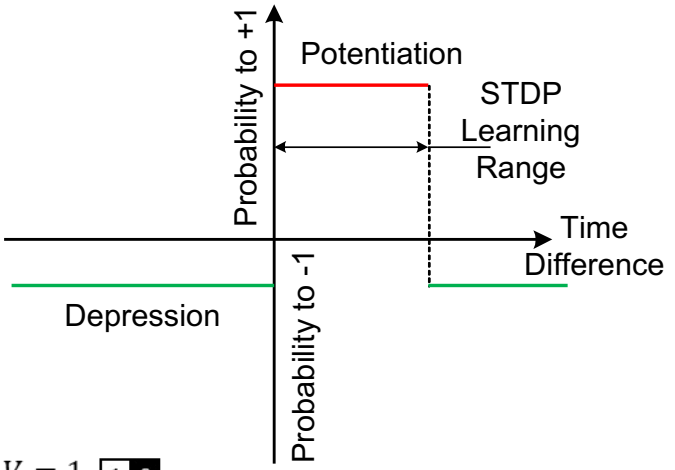


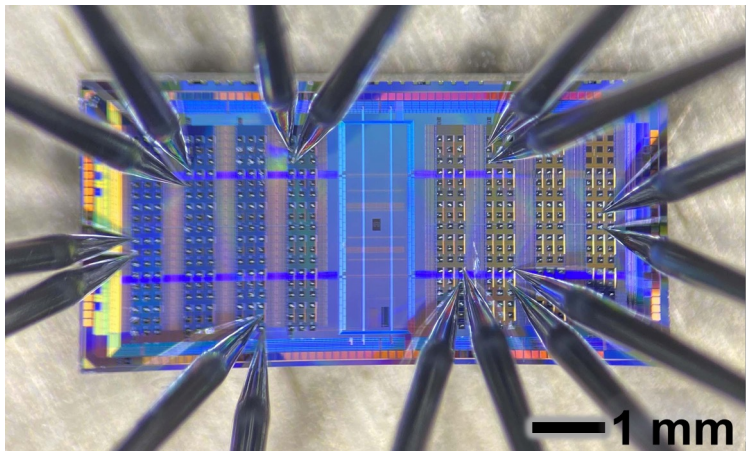
Backpropagation

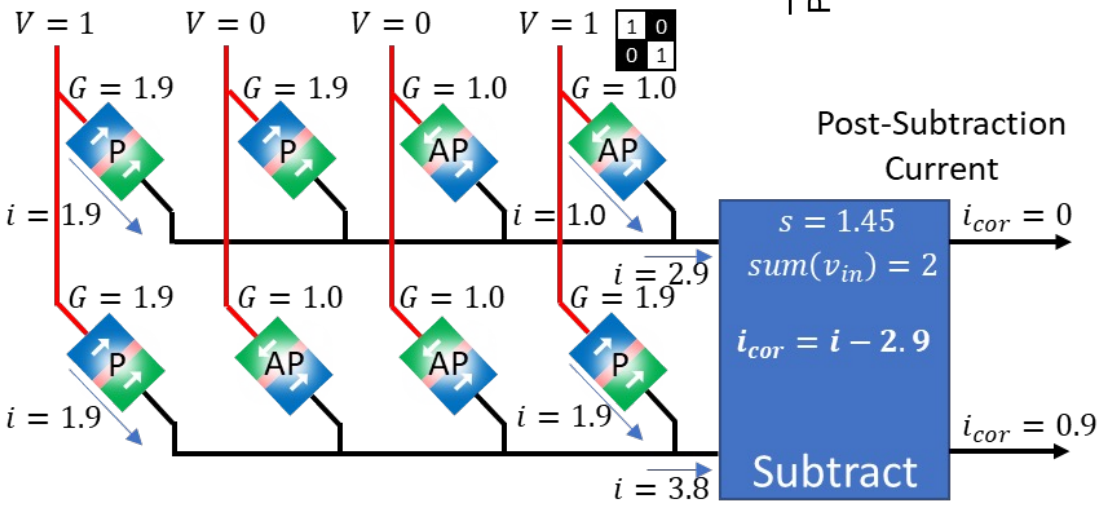
Online Learning & Inference: Unsupervised Stochastic STT-MRAM Switching











A. F. Vincent, J. Larroque, N. Locatelli, N. Ben Romdhane, O. Bichler, C. Gamrat, W. Zhao, J.-O. Klein, S. Galdin-Retailleau, D. Querlioz, *IEEE TBioCAS*, 2015

SYNOPSYS®

Metaverse and Agribusiness

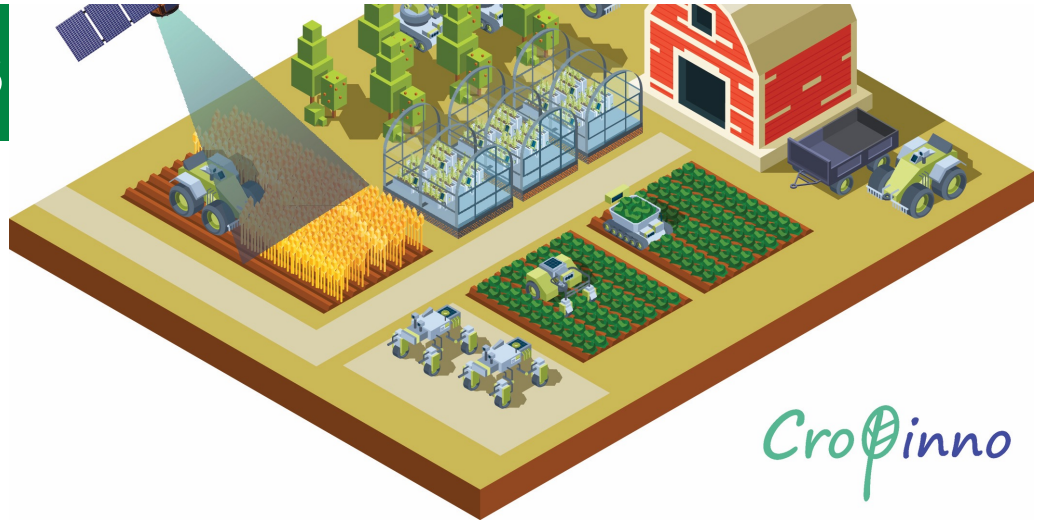
Victor Grimblatt

April 2023

Background

- Population is growing.
- Arable land is decreasing.
- Climate change is a major challenge for agriculture.
- One third of GHG emissions is caused by agriculture, forestry, and change of land use.
- For 2050 current agricultural production needs to be increased by 70%.
- 70% of “blue water” withdrawals from watercourses and ground water are destined to agricultural usage.
- Agriculture global water demand is estimated to increase by 19% by 2050.

Metaverse and Agribusiness



- Digital twins
  - Livestock management
  - Arable farming
  - Indoor farming
  - Improving sustainability (tracking of carbon, biodiversity, pollinator and water catchment services)
- Handle the farm virtually
  - Usage of satellites, sensors, and drones.
  - Can handle the farm on a tablet without being there.
  - Usage of AR to check the status of the farm (animals, crops, etc.).
- Interaction with suppliers
  - Participation at fairs.
  - Buy seeds and fertilizants virtually and get the product directly in the farm.
- Improving the farm experience
  - Virtual trainings.
  - Simulation of crops growth.
  - Simulation of pests and other crop diseases.


Is this ethical?
+20%
7 GALLONS
(27 LITERS)
6 GALLONS
(22 LITERS)

Metaverse and Climate Change

- Increase the usage of network resources --> more electricity.
- Needs more bandwith and resources that consume more.
- New technologis are helping to avoid this problem
  - WiFi 6
  - 5G, nG
- Current data center and servers optimize energy consumption.
- Underwater data centers, Microsoft is looking at that.
- According to International Energy Agency, while Internet traffic has increased bt 16.9% (2010 – 2020), energy consumption by data centers remain almost the same.
- Renewable energies.
- Less travels.

Metaverse and Climate Change

- Potential applications
  - Visualization of climate data
  - Global collaboration (worldwide projects)
  - Climate change simulations in different geographical areas
  - Education and awareness

My Concerns

- Ethics.
- Socialization.
- Data security.
- Reality vs Virtual.