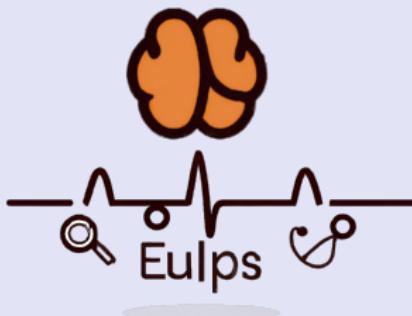


EULPS: Event-based Unsupervised Learning for Physiological Signals

Thomas Moreau Inria Saclay

Audition ERC StG 2023 – PE6



General Anesthesia Monitoring

IntelliVue

ECG

Indicators

Pleth.

Resp.

EEG

58

97

103/48 (68)

12

35

62

30

35.8

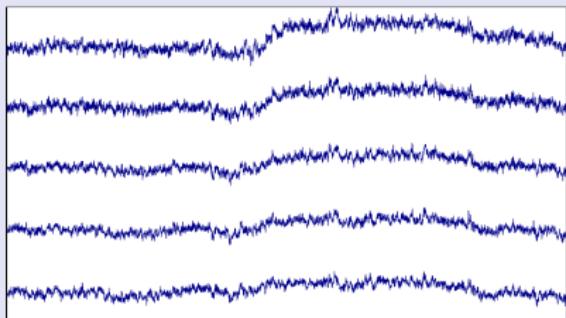
Perf 5.8
PVI 4.80
PVI 3
VPP 5

O₂-f_e 25
O₂-In 32

MAC 0.0

RS 30

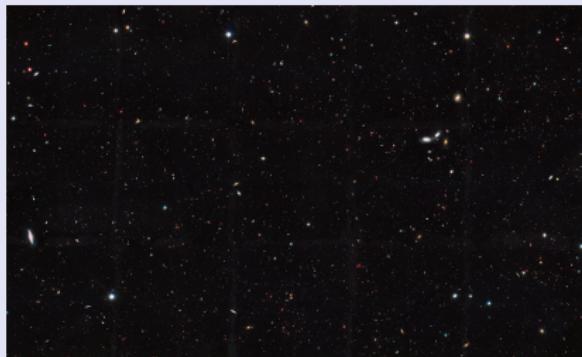
Large Scale Multivariate Physical Signals



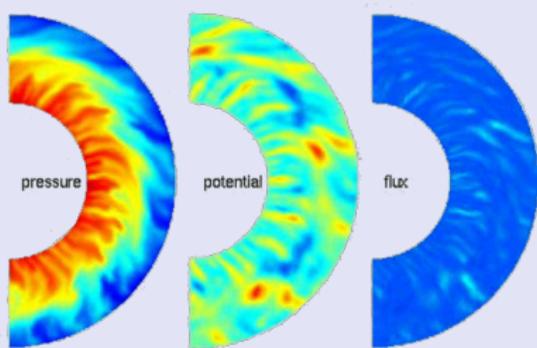
Neuroscience (MEG)



General Anesthesia

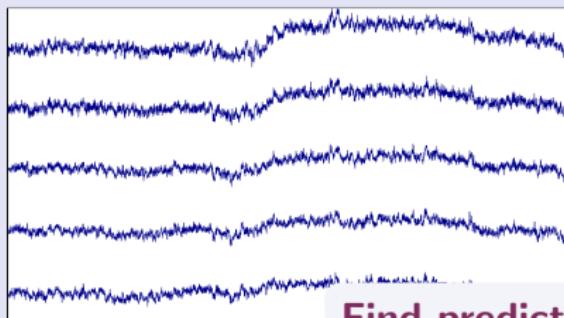


Astronomy



Physical Simulation

Large Scale Multivariate Physical Signals

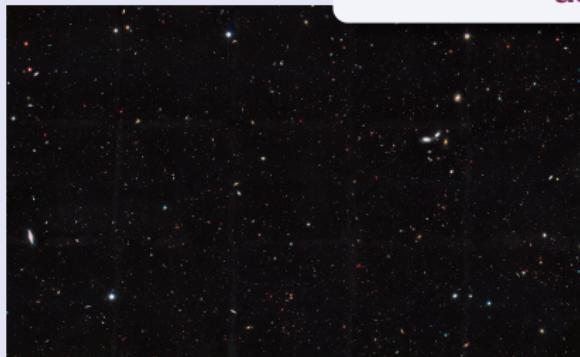


Neuroscience

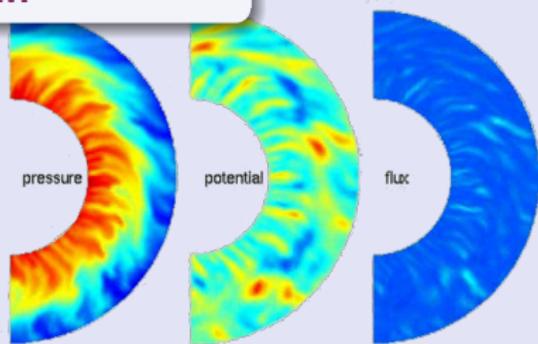
Find predictive representations
of multivariate signals
using AI.



Anesthesia



Astronomy



Physical Simulation

Recent breakthrough in AI: Foundation Models



ChatGPT



Midjourney

What do they have in common?

Recent breakthrough in AI: Foundation Models



ChatGPT



Midjourney

What do they have in common?

Tokens

Self-supervised pretraining

Capture the input distribution $\mathbb{P}(X)$ with interaction between tokens.

Recent breakthrough in AI: Foundation Models



ChatGPT



Midjourney

What do they have in common?

Tokens

Self-supervised pretraining

Capture the input distribution $\mathbb{P}(X)$ with interaction between tokens.

Challenges for signals:

- ▶ What are the tokens of the signals?
- ▶ How to derive more interpretable models?

Signals' Tokens: Events

IntelliVue

Observed events

Drug injection

Surgery acts

Adverse outcomes

Latent events

Heartbeat

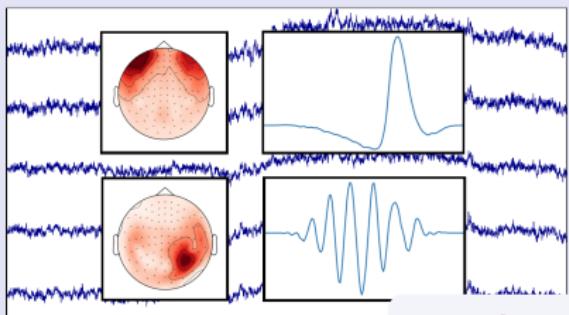
Dichroto wave

Breath Cycle

Brain waves

113/63 (73)

Signals' Tokens: Events

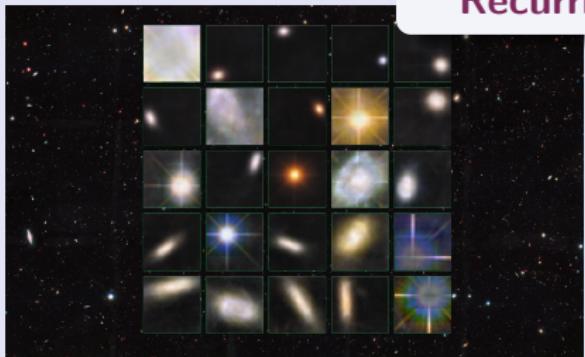


Neuroscience (N)

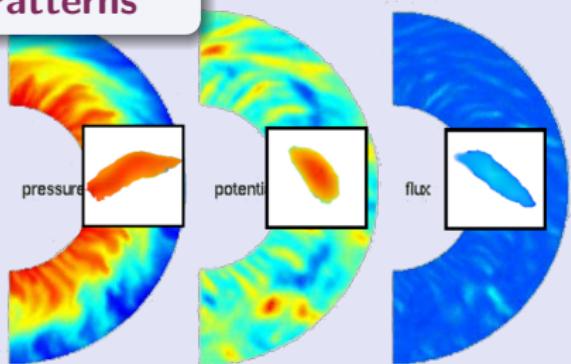


Medical Anesthesia

Latent Events
are characterized by
Recurring Patterns



Astronomy



Physics Simulation

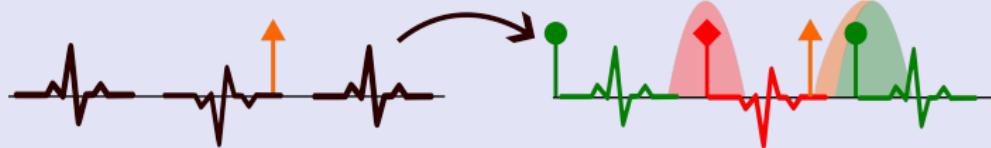
EULPS: Event-based Unsupervised Learning for Physiological Signals

EULPS Goal

Model the Distribution of Events for Physiological Signals.

Hyp.: Events' time distribution $\mathbb{P}(\{t_k\}_k)$ is much simpler than $\mathbb{P}(X)$.

Challenge: Need to transform signals into events and model their distribution jointly.



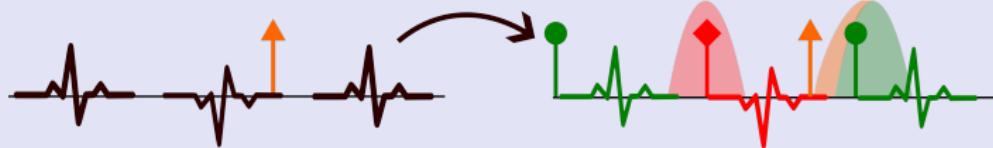
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Events' distribution
models

Joint Modeling of
Signals and Events

Task-specific
Fine-tuning Algo.