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Oscar Uzdelewicz - Computational Neuro & BCIs

Oscar Uzdelewicz — Computational Neuroscience Researcher

Oscar Uzdelewicz, an NYU mathematics and physics student, on computational neuroscience: what brain-computer interfaces can read today, the geometry of neural activity, and where it leads.

1,000s

of neurons read by an implant today, out of tens of billions [10:21](#)

1,000

dimensions when a thousand neurons are plotted together [22:26](#)

20 yrs

his horizon for curing most accidental paralysis [30:44](#)

\$1B

the imagined budget he splits between two brain projects [36:37](#)

KEY TAKEAWAYS

1 Model the brain, don't just describe it

Biology teaches facts about a system; maths and physics let you model it. He expects physics-based methods to come to dominate neuroscience. [3:27](#)

2 A foundation model for brain signals

Synchron plans one model to interpret anyone's neural activity, which could cut the long calibration every implant needs today. [7:01](#)

3 Implants read a tiny sample

Today's interfaces record from thousands of neurons out of tens of billions, and some only average the activity nearby. [10:21](#)

4 Repair first, diagnosis second

Interfaces are built to restore function, such as walking after paralysis. Spotting disease in the recordings would be a by-product. [15:01](#)

5 Neural activity has a shape

Give each neuron an axis and a stimulus traces out a surface. The lab's example: a dog and a cat land on separate spheres. [23:41](#)

“In the long term, these physics-based methods are going to, if not completely replace, dominate the more traditional ways of understanding the brain.”

Oscar Uzdelewicz · [4:54](#)

CHAPTERS

0:00	Intro	1 min	14:24	Could implants diagnose disease?	6 min
0:47	What computational neuroscience is	2 min	20:13	A summer at the Flatiron Institute	7 min
2:42	Why switch to maths and physics	3 min	26:56	The geometry, restated	3 min
5:42	Research worth knowing about	1 min	29:36	Medicine in 20 years	5 min
6:24	Synchron's foundation model	3 min	34:23	Imaging and the MRI	2 min
9:19	Can we read the brain accurately?	3 min	36:25	Spending a billion dollars	7 min
12:04	Beyond electrical signals	2 min	43:45	A question for the next guest	2 min
			45:15	Outro	1 min

TERMS EXPLAINED

Computational neuroscience

Using mathematics and computation to understand how the brain works.

Foundation model

A large AI model trained on broad data that can be adapted to many tasks.

Firing rate

How often a neuron fires: the usual measure of its activity.

Brain-computer interface

A device that records brain activity and turns it into commands for a machine.

Neural manifold

The surface that a group of neurons' activity traces out when plotted together.

Neurodegenerative disease

A condition, such as Alzheimer's or ALS, in which neurons progressively die.

MENTIONED IN THIS EPISODE

Synchron

Neuralink

Flatiron Institute

AlphaFold

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