

UF | College of Medicine
UNIVERSITY of FLORIDA

Synapses & Circuits: Harnessing AI in Neurology

January 21st, 2025



Disclosures:

Contracted Research (Principal Investigators must provide information, even if received by the institution):

Edgewise Therapeutics

Define what is AI?

Why is it important in healthcare and in Neurology?

List one new way to use AI today.

- How is AI being used in Neurology now?
- How can I play around with it?
- Demos.

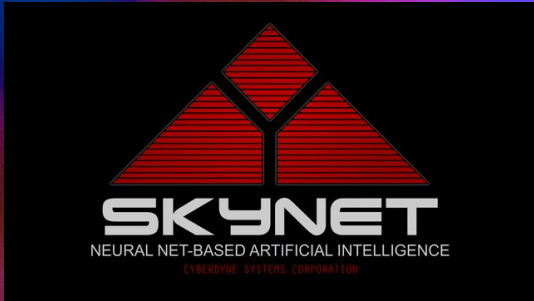
Discuss how AI will be used in near future.

- How it can help us to be effective, efficient, possibly happier neurologists?
- Can a neurologist using AI be better than either alone?

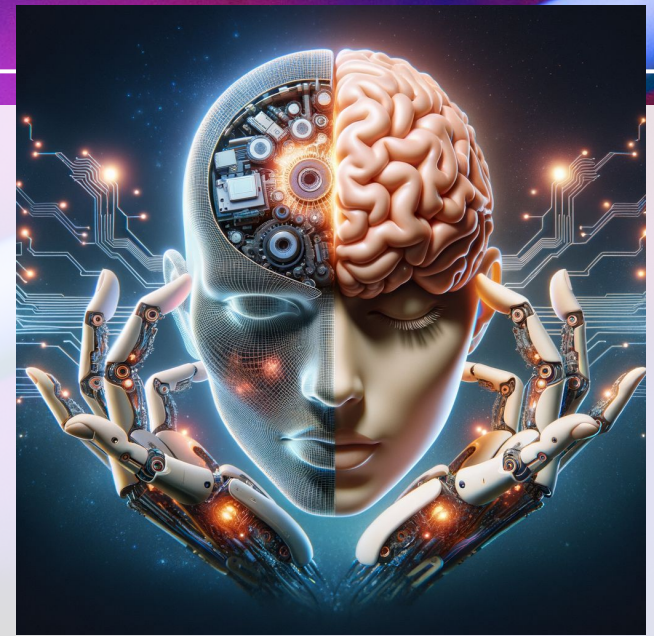
Recognize Pitfalls and Limitations.

Misinterpretations, bias, ethical, and legal considerations.





Skynet Terminator logo.png



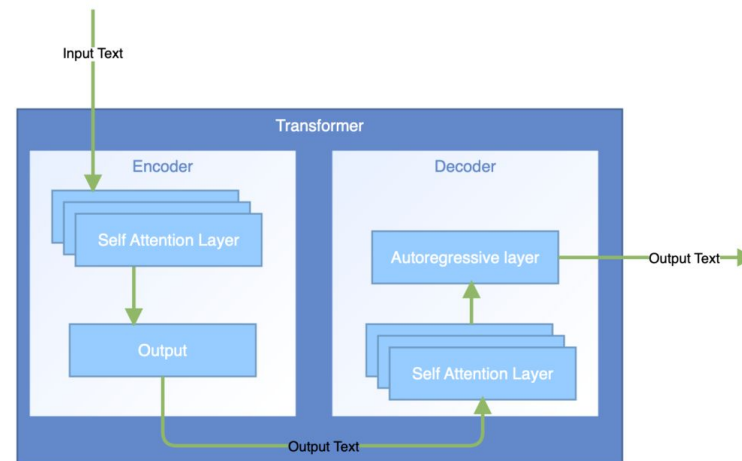
What is AI?

"The study of agents that receive percepts from the environment and perform actions."

Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach (4th Edition).

||||| What is AI?

- Takes Data in the form of nodes and evaluates for patterns and connections on multiple levels simultaneously.
- “Big and Broad” vs “Small and Deep”.
- Even the developers are disoriented at how fast the technology is changing.
- Video Card Evolution and Transformers.



How do you feel about AI today?



0%



0%

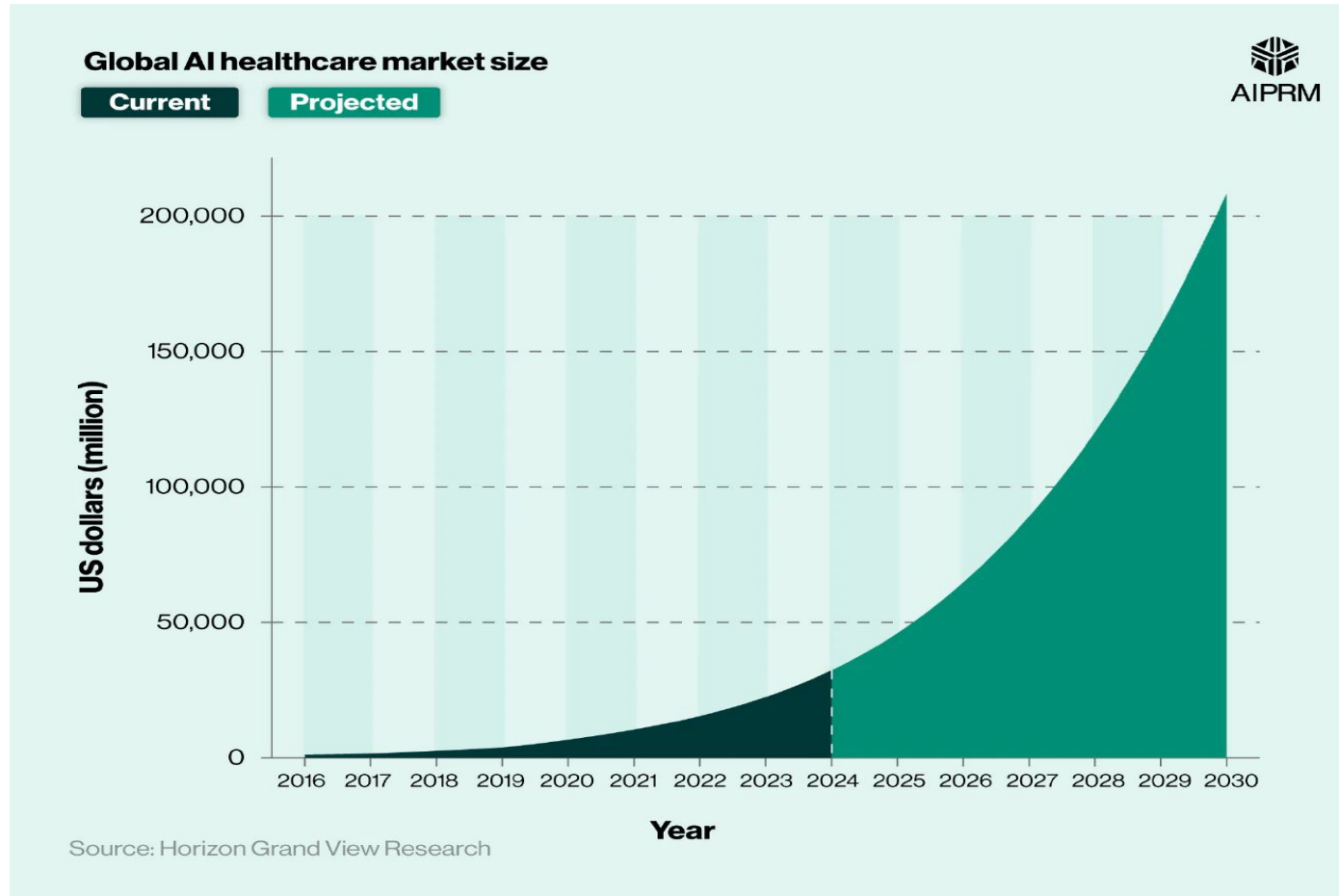


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AI is Changing Medicine (Now)




“

“How should we use AI is like asking how we should use Electricity”

John Morren, M.D.

Uses of AI in Neurology

As answered by GPT 4.0

- 
1. Patient Education: Providing clear, comprehensible explanations of neurological conditions, treatment options, and procedures to patients and their families.
 2. Medical Documentation: Assisting in generating and organizing patient notes, summaries, and reports, which can save time and enhance the accuracy of medical records.
 3. Research Assistance: Helping to quickly summarize the latest research findings, reviewing literature, and identifying relevant studies related to specific neurological conditions.
 4. Diagnostic Support: Offering suggestions for differential diagnoses based on patient symptoms and clinical data, potentially uncovering less obvious conditions that should be considered.
 5. Treatment Planning: Assisting in the formulation of evidence-based treatment plans by synthesizing the most up-to-date guidelines and research.

How do you want to use AI in your practice?

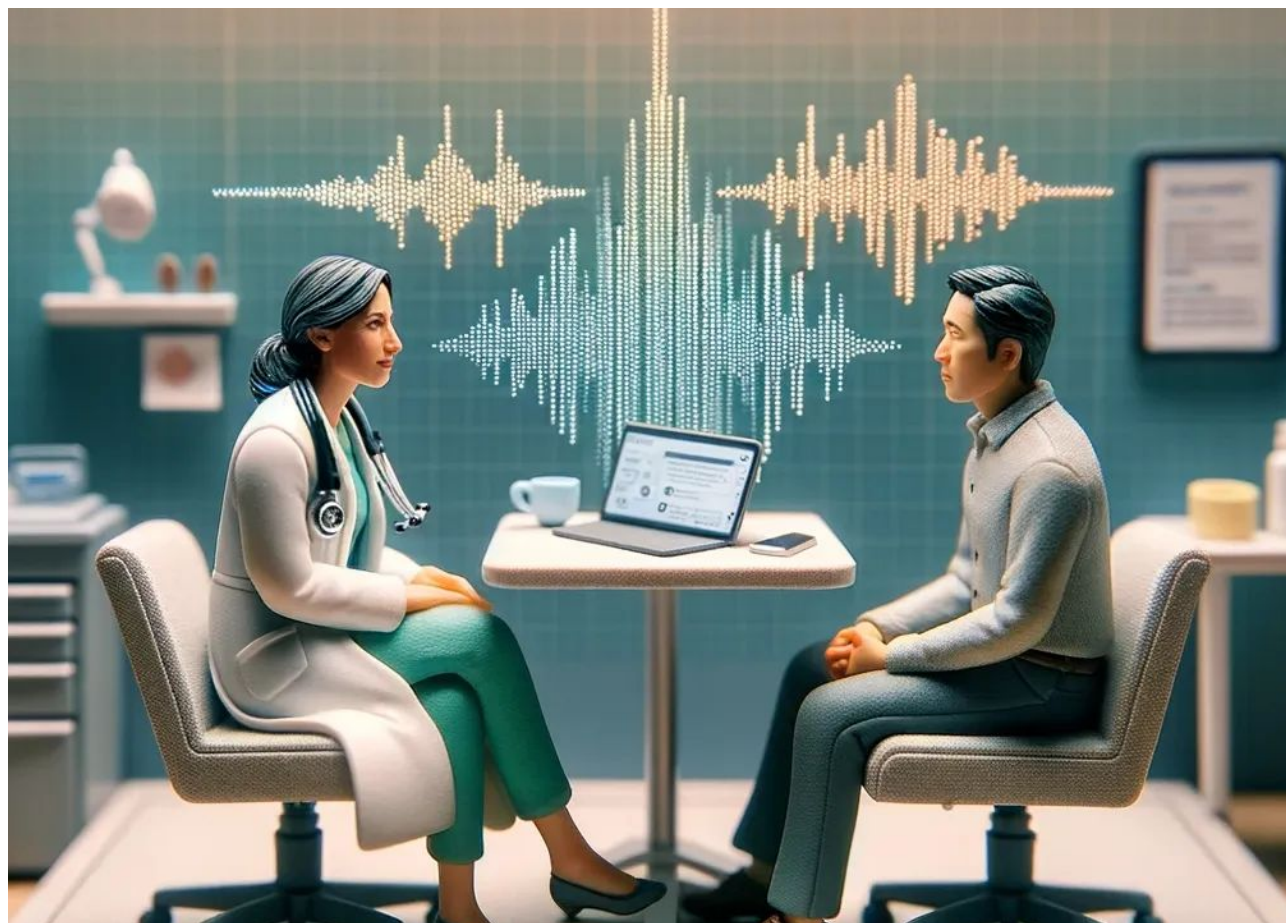
Nobody has responded yet.

Hang tight! Responses are coming in.

||||| Ambient Scribe Technology



Screen shot of simulated visit planned.



AI Patient Actor

Medical Simulations

<https://ai.dartmouth.edu/patient-actor>

DARTMOUTH LIBRARIES

Neuroscience-Informed Learning & Education Lab
Geisel School of Medicine at Dartmouth

AI Patient Actor

Instructions

Settings

Mode selection: Foundational OnDoc

Select case: A Demo Case

Select language: English

Doctor input: Text-only Speech + Text

Patient response: Text Speech

End Patient Encounter and Receive Feedback

AI Patient interview

Hi! I am Dr. X. What brings you to the clinic today?

Created by [NILE Lab](#) and [RDS @ Dartmouth Library](#). For questions, please contact [Thomas Thesen](#).

AI Search Engine for Research

Find & understand the best science, faster.

Ask the research...



 Does exercise improve cognition? 

 Can cash transfers reduce poverty? 

 Are statins effective in the elderly? 

 Can mindfulness help with sleep? 

[Try an example search](#)

See how it works

 [Watch now](#) • 1 min


||||||| NoteGPT

For Learners and Educators

Detail Dark Light English

< Advancing Teaching & Training through Educational Scholarships: Top Articles in Neurology: Education

Story: my last clinic ...



Wake Forest University School of Medicine

Transcript Discover

00:00
uh welcome everybody uh it's been a real pleasure to have Dr stoud again uh Dr stoud as you know is uh the associate professor of Neurology and oncology at Wake Forest University School of Medicine he is the director of the NF and TSC Clinic he's also a well-known respected neur oncologist a clinical trialist involved in multiple trials in multiple areas of neurooncology including neurocutaneous syndromes expert in brain tum...

00:31
by discovering new treatments and new tools to assess whether treatment is working and improving the quality of life for patients uh he's a Wake Forest uh president trainee as well as medical student did his fellowship with John Hopkins and further in medical education um today's uh he's going to give us a completely different Focus uh he's well respected in the American Academy of Neurology and does a lot of education...

01:00
also an author of a great textbook if you have time to read it it's the neur oncology textbook it's a really great read if you're are not neuronist and you want a quick view it's excellent cases for residents today he's going to focus mainly on education he's also the undergraduate Vice te for education at the school of medicine at Wake Forest University so thank you so much Dr Stout for joining us again today uh and the real pleasure ...

AI Notes AI Chat Summarize

Summary

Dr. Stoud emphasizes effective teaching strategies for busy neurology practitioners, focusing on enhancing education alongside patient care.

Highlights

- **Teaching on the Go:** Strategies for integrating teaching into clinical practice.
- **Efficiency:** Teaching can improve productivity without slowing down clinical work.
- **Goal Setting:** Establishing clear expectations enhances learning for students and residents.
- **Modeling:** Demonstrating clinical reasoning helps students understand complex cases.
- **Feedback:** Regular feedback is crucial for learner development and improving teaching methods.
- **Documentation:** Engaging learners in documentation enhances their understanding and efficiency.
- **Collaborative Learning:** Encouraging learners to research and teach back fosters active engagement.

Key Insights

- **Teaching as a Two-Way Process:** Effective teaching involves understanding learner expectations and needs, promoting a collaborative learning environment that benefits both parties. This approach fosters a more engaged and interactive clinical experience.
- **One-Minute Preceptor Model:** This model allows for quick, focused teaching moments that can enhance learning without taking extensive time away from patient care. By utilizing short interactions, educators can maximize educational impact.
- **Role of Feedback:** Providing consistent feedback helps learners improve their clinical skills and confidence. It's essential to normalize feedback within the clinical environment to promote a culture of continuous improvement.
- **Efficiency through Engagement:** Incorporating learners into clinical documentation and decision-making processes not only enhances their learning but also improves overall clinic efficiency, benefitting patient care.
- **Setting Clear Goals:** Establishing clear educational objectives at the start of clinic sessions helps guide learners and ensures both the educator and learner are aligned on expectations.
- **Utilizing Technology:** Employing AI and other tools for documentation can streamline processes, allowing educators to focus more on teaching while maintaining high-quality patient care.
- **Lifelong Learning Culture:** Emphasizing the importance of ongoing education and curiosity encourages students and residents to become proactive in their learning, preparing them for future challenges in their medical careers.

Summary



Open Evidence

<https://www.openevidence.com/ask/d592d0dd-2708-48d5-aa9a-6040ce8f79a6>

||||| AI in the very near future

- Summarize an entire chart and highlight any desired information.
 - Needs to be in a HIPAA compliant setting.
- Answer patient portal messages and automate our inboxes.
- Conduct preliminary interviews (e.g. orthopedics).
- Imaging: Biomarkers in ALS, and neurodegenerative diseases.
- Pathology
- Genetics
- EMG: 150,000 data points/second.
 - Single-fiber EMG
 - Barriers to use

ChatGPT-01 (Strawberry)

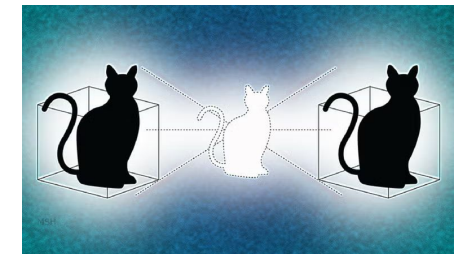
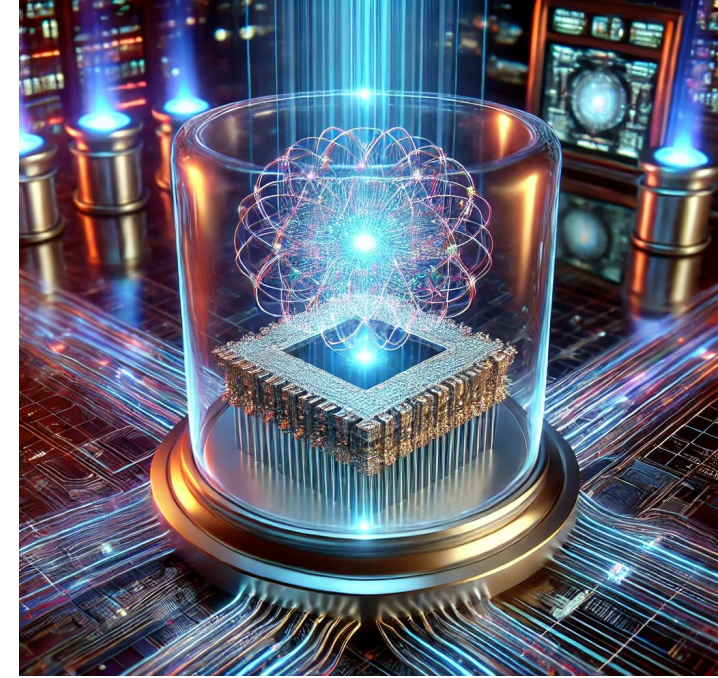
Released September 12th 2024

- Self-teaches through penalties and rewards.
- Uses chain of thought and self-questioning.
- Reduces hallucinations significantly, though not eliminating them.
- Three times as expensive to use as 40.

Quantum Computing

Qubits

- 0 or 1?
 - Can be both!
- Entanglement:
 - Manipulating one qubit instantly affects the state of other qubits.
- Allows faster analysis of large, complex datasets.



||||| Pitfalls and Limitations

- Distrust by patients.
- Slow to adopt by physicians.
- HIPAA compliance—No personal health information or potential for identification!
- Hallucinations
- Lack of quality data.
- Bias against minority groups and ethnicities.
- Legal ethics: who is responsible when AI makes errors?
- Copyright laws?



||||| Hallucination-Example

avatar

describe the dragon ambient experience to neurologists

NaviGator Chat:

Dragon Ambient Experience: A Neuroscientific Analysis

The Dragon Ambient Experience, composed by pianist William Ackerman, is a soothing ambient music piece designed to create a calming atmosphere. For neurologists, this music can provide insight into the effects of sensory stimulation on brain function. Let's examine how the Dragon Ambient Experience interacts with the brain, influencing emotions, perception, and cognitive processes.

Brain Regions Involved

When listening to the Dragon Ambient Experience, several brain regions become engaged:

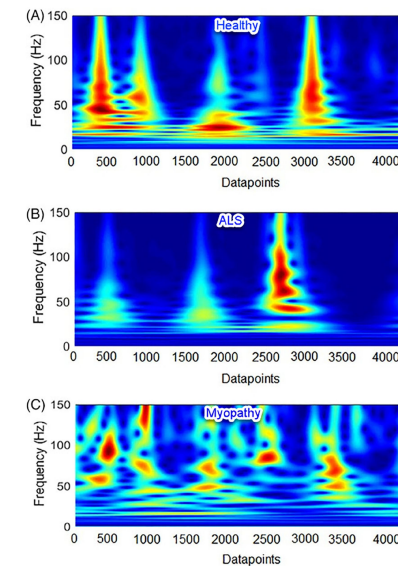
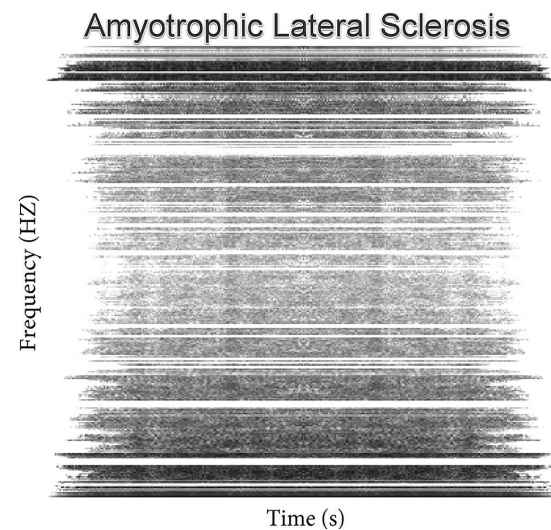
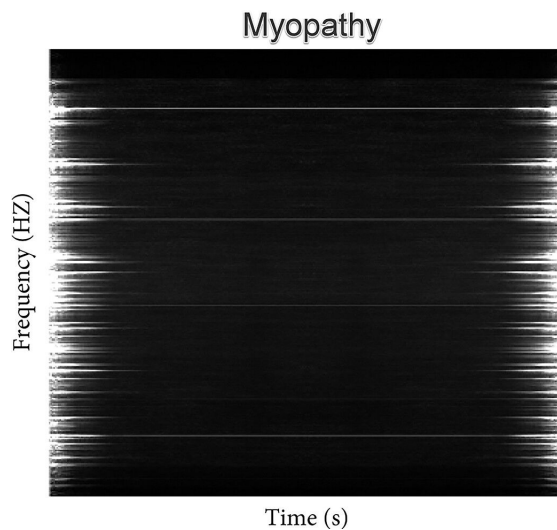
AI in EDX

The role of artificial intelligence in electrodiagnostic and neuromuscular medicine: Current state and future directions

Mohamed A. Taha MD, MSc, MSc, John A. Morren MD

First published: 27 December 2023

- One second of EMG data produces 50,000 data points!
 - considered stochastic (randomly determined) and high-dimensional, providing elaborate insight into the electrical characteristics of motor units.
- Needle or patient movement artifact is difficult to interpret mathematically.
- Principle Component analysis: Time domain, Frequency domain, or Time/Frequency domain

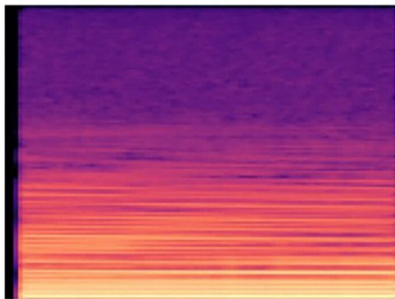


EMG

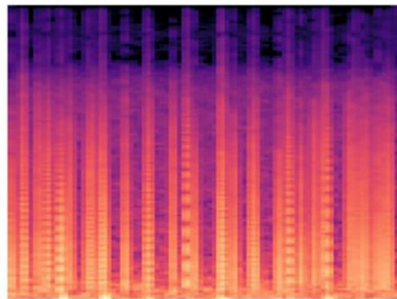
- Need for databases with good quality data.
- Still determining which analysis techniques work best.
 - Random Forest Classifier (RFC)
 - Decisions trees get to “vote”.
- Recent advances use “Raw signal” without processing.
 - Able to differentiate ALS vs normal in 1 second clip at >98% correct.

Spontaneous Activity

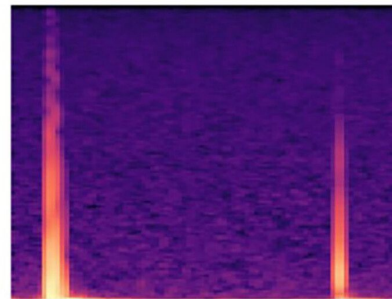
- Mel spectrogram transformation:
- Has difficulty labeling complex repetitive discharges as myotonic discharges or endplate potentials as fibrillation potentials.



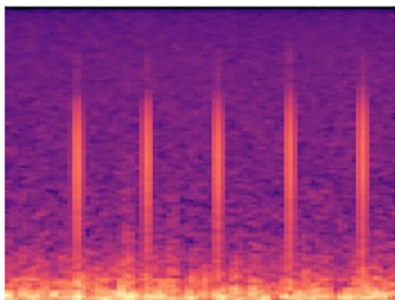
CRD



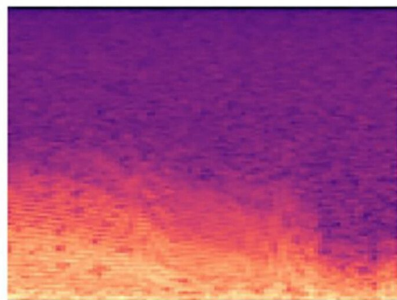
Endplate potentials



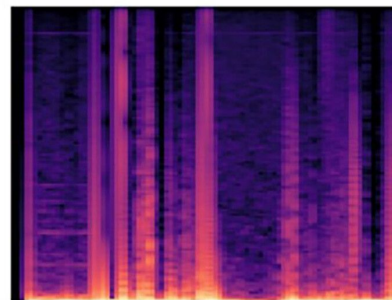
Fasciculation potentials



Fibrillation/PSW



Myotonic discharges

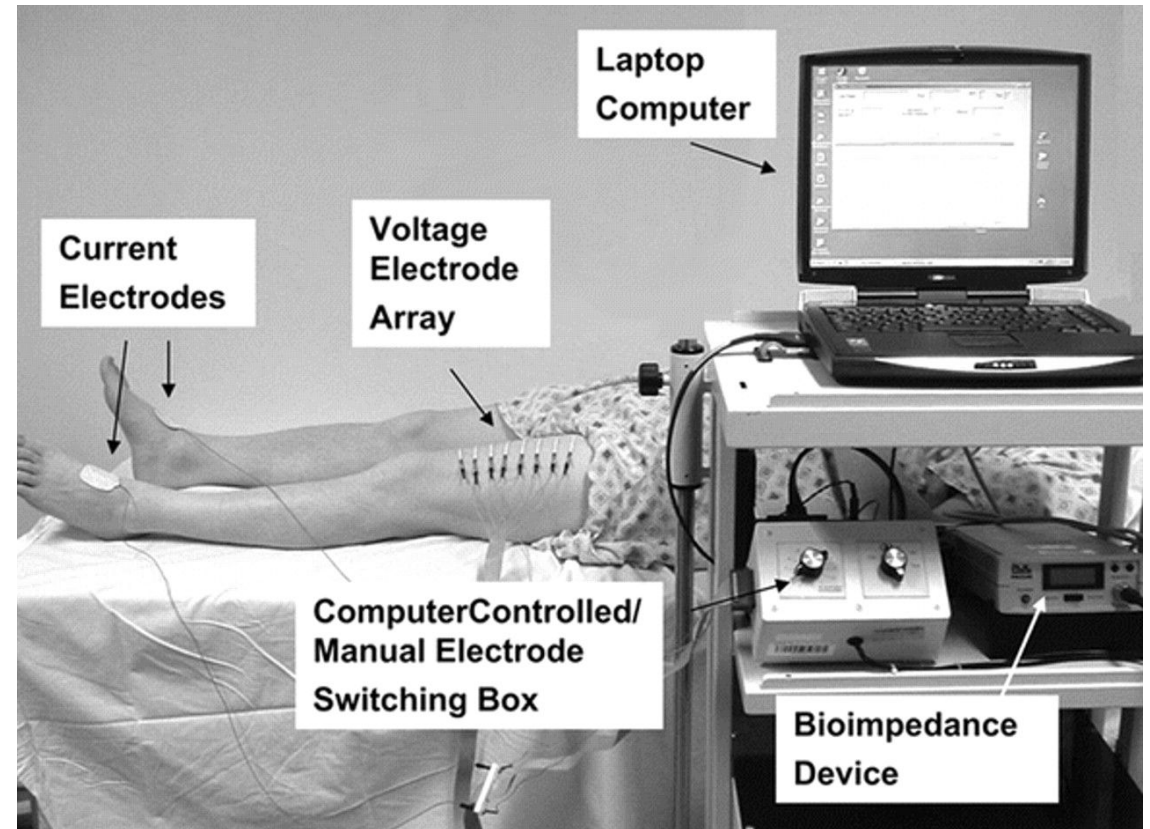


Noise artifacts

1 s

Electrical Impedance Myography

- May improve monitoring of disease progression.
- Muscle composition, size, atrophy, or fibrosis.



Research

Neuromuscular Ultrasound

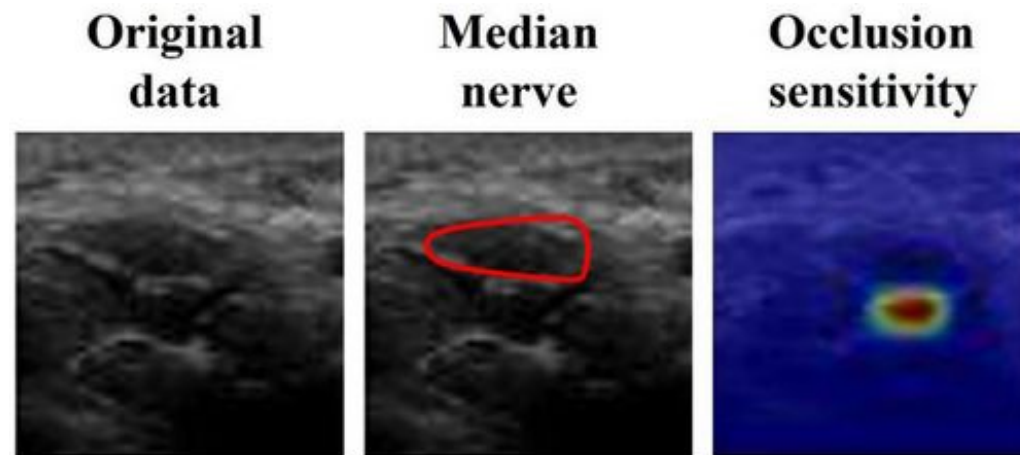
Using deep learning for ultrasound images to diagnose carpal tunnel syndrome with high accuracy

Author: Issei Shinohara, Atsuyuki Inui, Yutaka Mifune, Hanako Nishimoto, Kohei Yamaura, Shintaro Mukohara, Tomoya Yoshikawa, Tatsuo Kato, Takahiro Furukawa, Yuichi Hoshino, Takehiko Matsushita, Ryosuke Kuroda

Publication: Ultrasound in Medicine & Biology

Publisher: Elsevier

Date: October 2022



Other uses in Neuromuscular

- Before and after neostigmine photos for MG.
- Video analysis of MG faces judging severity.
 - AI-94%, neurology expert-63%.

Summary:

- Transformative Impact:
- Innovative Technologies:
- Deep Learning Advancements:
- Addressing Challenges:

