



Herbert Wertheim
College of Engineering
UNIVERSITY *of* FLORIDA

POWERING THE NEW ENGINEER TO TRANSFORM THE FUTURE

J. C. PRUITT DEPARTMENT OF BIOMEDICAL ENGINEERING

BEEC Share & Learn

TENS in Bio-Signals & Systems

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Challenge

- BME 3508 – Biomedical Signals & Systems (junior level class)
 - Provides fundamental concepts for mathematical modeling of biologically/clinically – relevant signals & systems.
 - Most concepts are very abstract
- Common solution
 - link to BME applications
- Lack of meaning persists. Signal properties like amplitude, frequency, energy, power, mean – what do the numbers mean?

Initiative

- How do I make my students *experience* signal properties?

Transcutaneous Electrical Nerve Stimulation (TENS) Learning Activity

TENS 7000 – dual channel stimulator



https://www.amazon.com/TENS-7000-Digital-Unit-Accessories/dp/B00NCRE4GO/ref=sr_1_1_sspa?crd=104PPOBCWCIML&keywords=tens+7000&qid=1699028804&sprefix=tens+7000%2Caps%2C87&sr=8-1-spons&sp_csd=d2lkZ2V0TmFtZTlzcF9hdCY&psc=1

TENS 7000 - learning activity

Assignment

4 Electrode positions

- Threshold of perception
- Vary amplitude, width, & rate
- Threshold of comfort

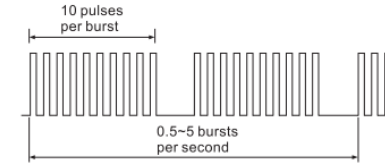
Stim modes:

- Burst – width 250µs, rate 5Hz
- Normal – width 250µs, rate 15 & 30Hz

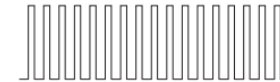
08.	Pulse Rate	Adjustable, from 2 to 150 Hz, 1 Hz/step
09.	Pulse Width	Adjustable, from 50 to 300 µs microseconds, 10µs/step
10.	Modes	B(Burst), N(Normal), M(Modulation), SD1 (Strength Duration), SD2
11.	Burst Mode	Burst rate: Adjustable, 0.5 – 5Hz Pulse width adjustable, 50~300µs Frequency fixed = 100 Hz
12.	Normal Mode	The pulse rate and pulse width are adjustable. It generates continuous stimulation based on the setting value.

The waveforms of the 5 stimulation modes are as follows.

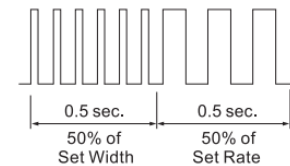
1. Burst



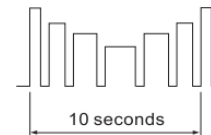
2. Normal



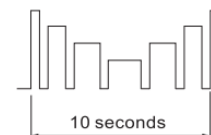
3. Modulation



4. SD1 (Strength-Duration)



5. SD2 (Strength-Duration)



What do you notice about these waveforms?

TENS UNIT ACTIVITY

OBJECTIVE

PREPARE

- Learn the basic principles of a Transcutaneous Electrical Nerve Stimulation (TENS) unit.
 - Explore a medical device that implements the mathematical concepts and theories discussed in class.
- ! Contact your instructor or TA if you face any technical issue or spot a typo.

TENS UNIT ACTIVITY

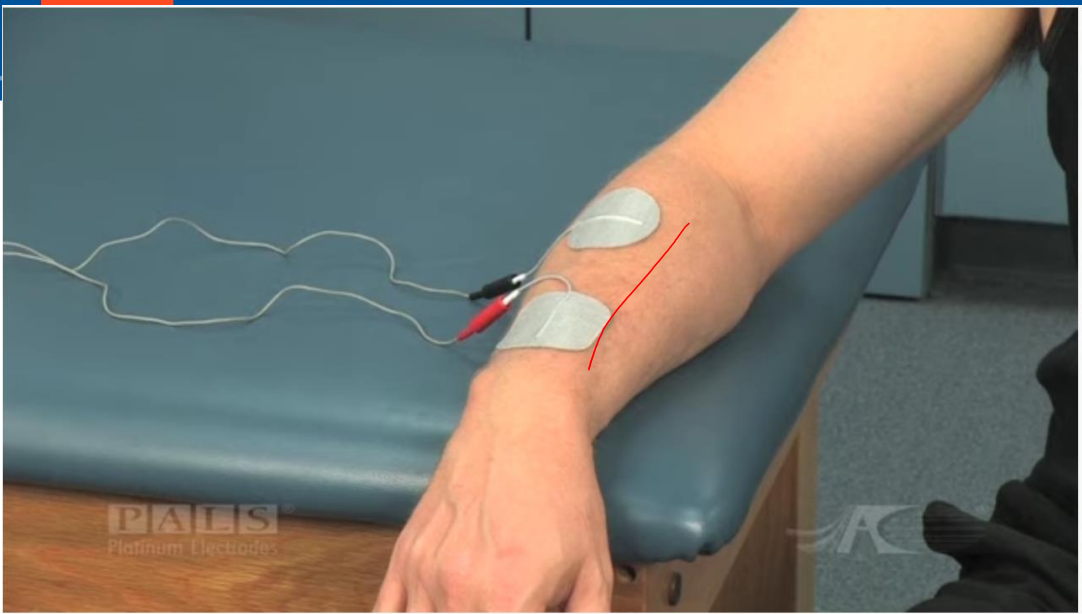
OBJECTIVE

PREPARE

- **Read** the [instructions manual](#) ↓ for the [TENS 7000 unit](#). ↗
- Pay close attention (i.e.: read) to the Cautions, Warnings, Contradictions, and Adverse Reactions sections.
- Mandatory Reading: chapters 1, 6, 7, 8, 12, 13, 17, 20
- Optional Reading: the rest of the manual.

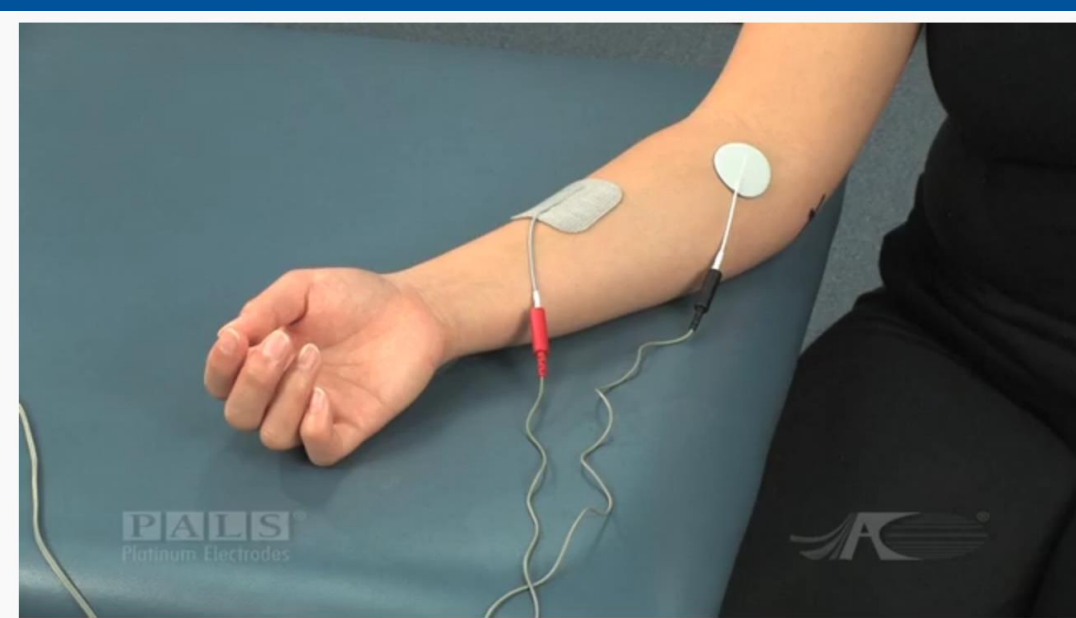
Before coming to class, please determine if you want to use the TENS 7000 unit on yourself. This will help with group formation.

You must complete this assignment to participate in the in-class activity. Certify your completion of the assignment by typing "I have completed the assigned reading, and I'm aware of the Cautions, Warnings, Contradictions, and Adverse Reactions" in the textbox below. You can also indicate your preference to use the device. Students who don't wish to use the device will still be allowed to explore the unit and collaborate with peers.



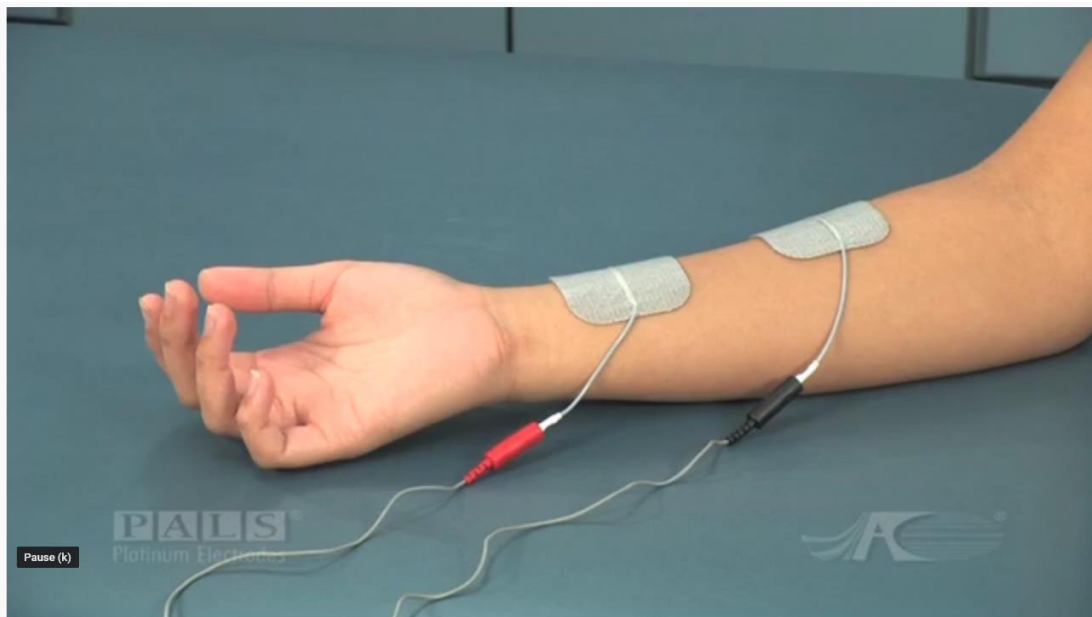
Electrode Placement Tutorials (Muscle Stimulation Series)
Wrist & Finger Extension Muscle Stimulation

<https://www.youtube.com/watch?v=Sfp2S-oBs24>



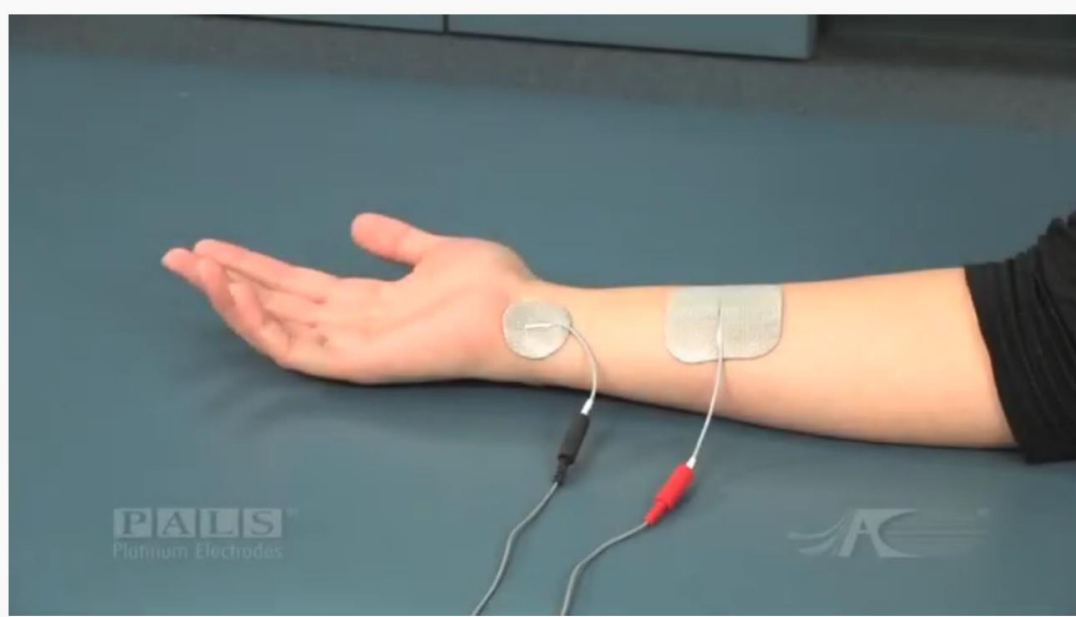
Electrode Placement Tutorials (Muscle Stimulation Series)
Electrode Placement for Forearm Pronation

https://www.youtube.com/watch?v=MVm_dae83MU



Electrode Placement Tutorials (Muscle Stimulation Series)
Electrode Placement for Finger Flexion

https://www.youtube.com/watch?v=MVm_dae83MU

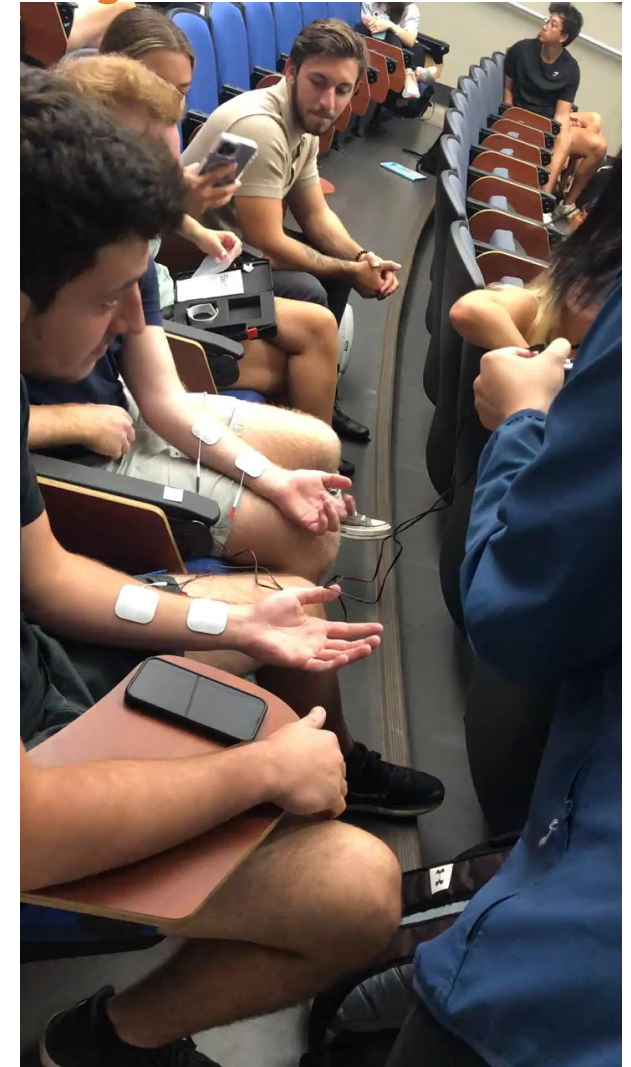


Electrode Placement Tutorials (Muscle Stimulation Series)
Electrode Placement for Lumbrical Grip

<https://www.youtube.com/watch?v=ZJym9Yz-j8Q>



Finger flexion



Wrist flexion



Reflection

- Device Design
- Personal Experience
- Relevance to other courses

Limitations

- Class size (good in <60)
- Students' buy in
- Students' obedience

Thank you
Question?