

ACTIVITY DETECTION FROM WEARABLE ELECTROMYOGRAM SENSORS USING HIDDEN MARKOV MODEL

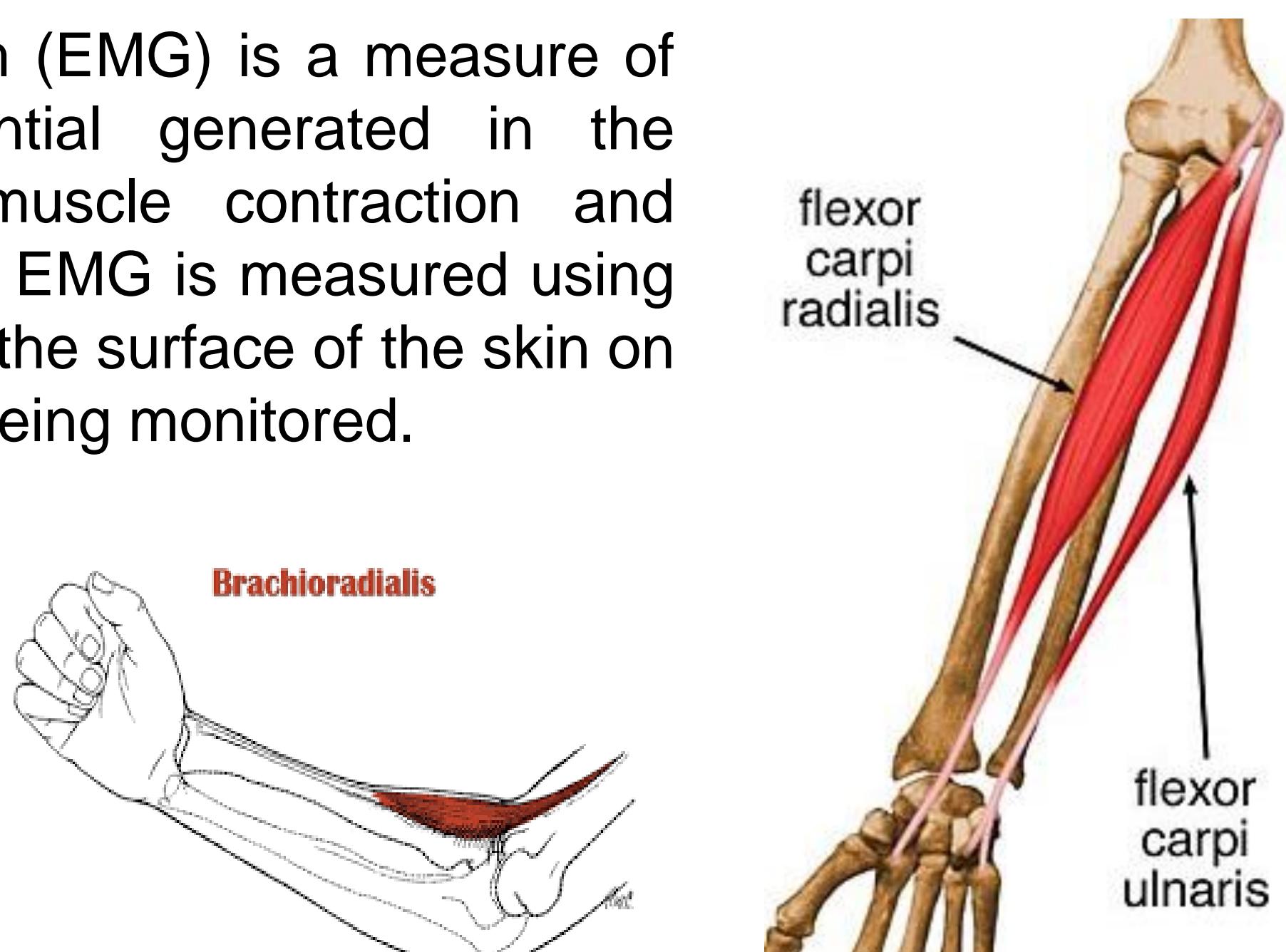
Karush Suri, Dr. Rinki Gupta

Department of ECE, Amity School of Engineering & Technology

INTRODUCTION

Electromyogram (EMG) is a measure of the electric potential generated in the muscles during muscle contraction and relaxation. Surface EMG is measured using sensors placed on the surface of the skin on top of the muscle being monitored.

Muscles being monitored

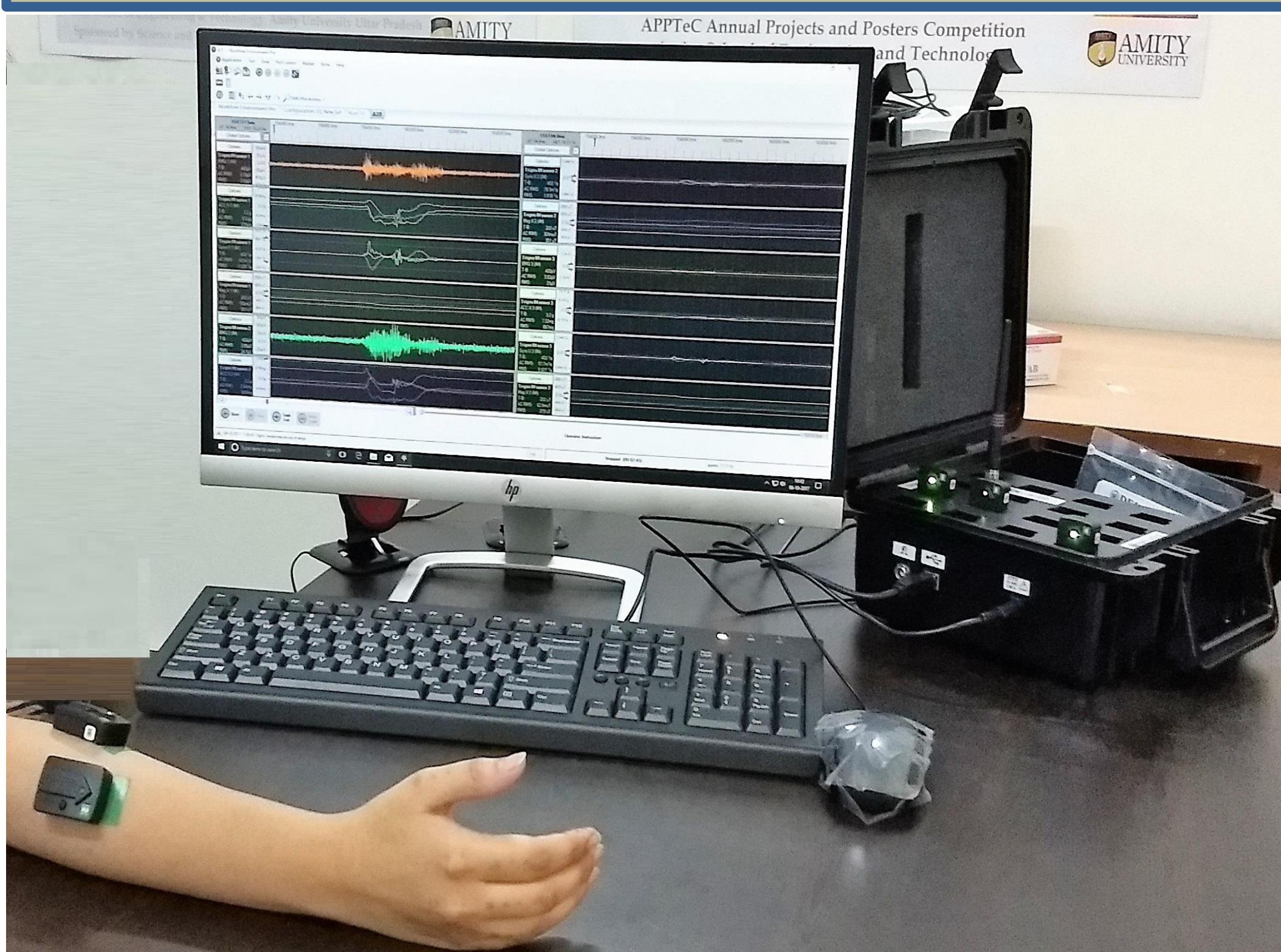


Surface EMG is useful for Hand Motion Analysis for Applications such as:

- ❖ Human Machine Interfaces
- ❖ Assistive technology, sign language recognition
- ❖ Prosthetic Control, Rehabilitation Sciences

EXPERIMENTAL SETUP

EMG System for Signal Recording



System Hardware consisting of Wireless Sensors

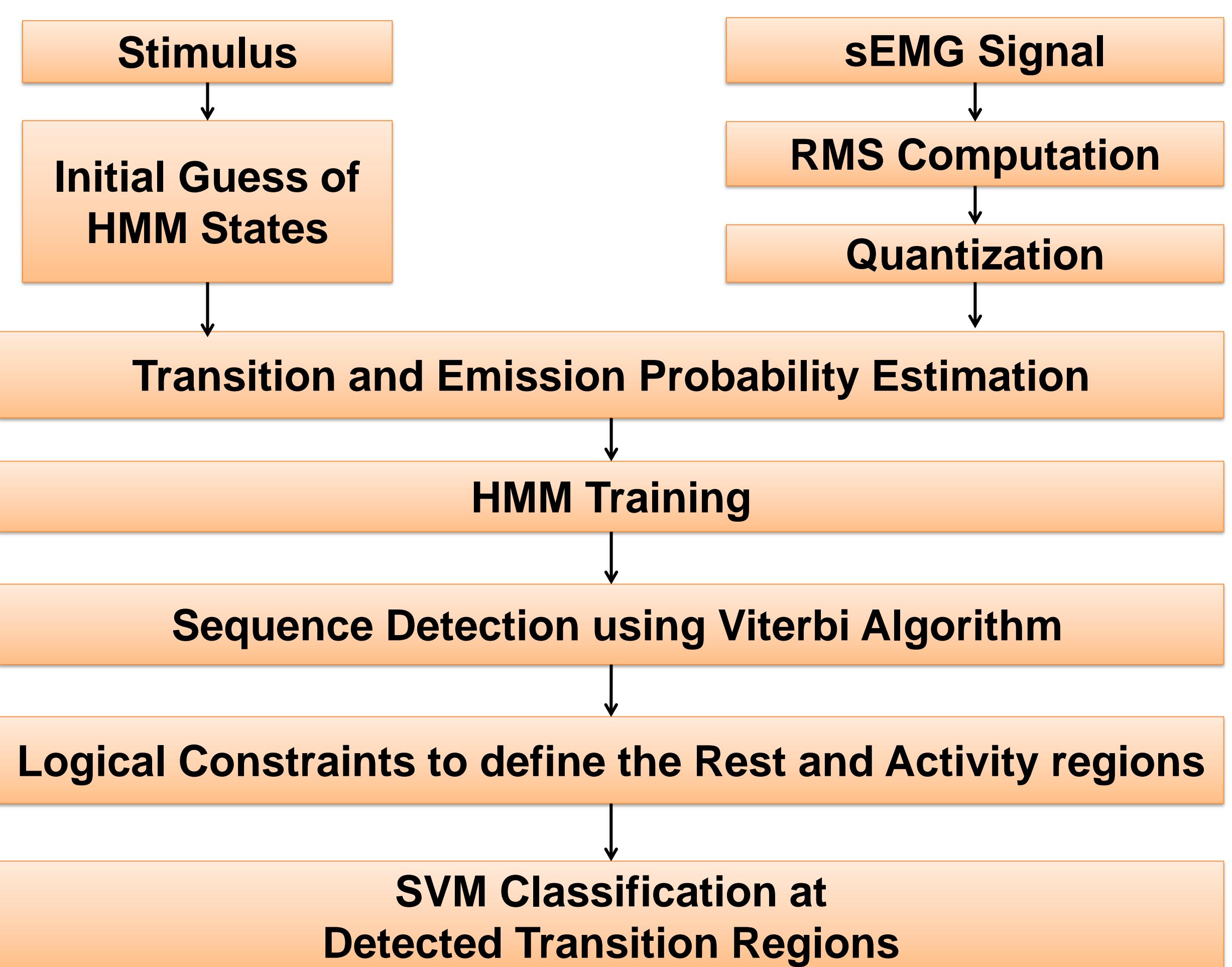


sEMG Sensors

Sampling Period: 900 usec
Resolution Depth: 16 bits
Bandwidth: 450 ± 50 Hz,
 >80 dB/dec

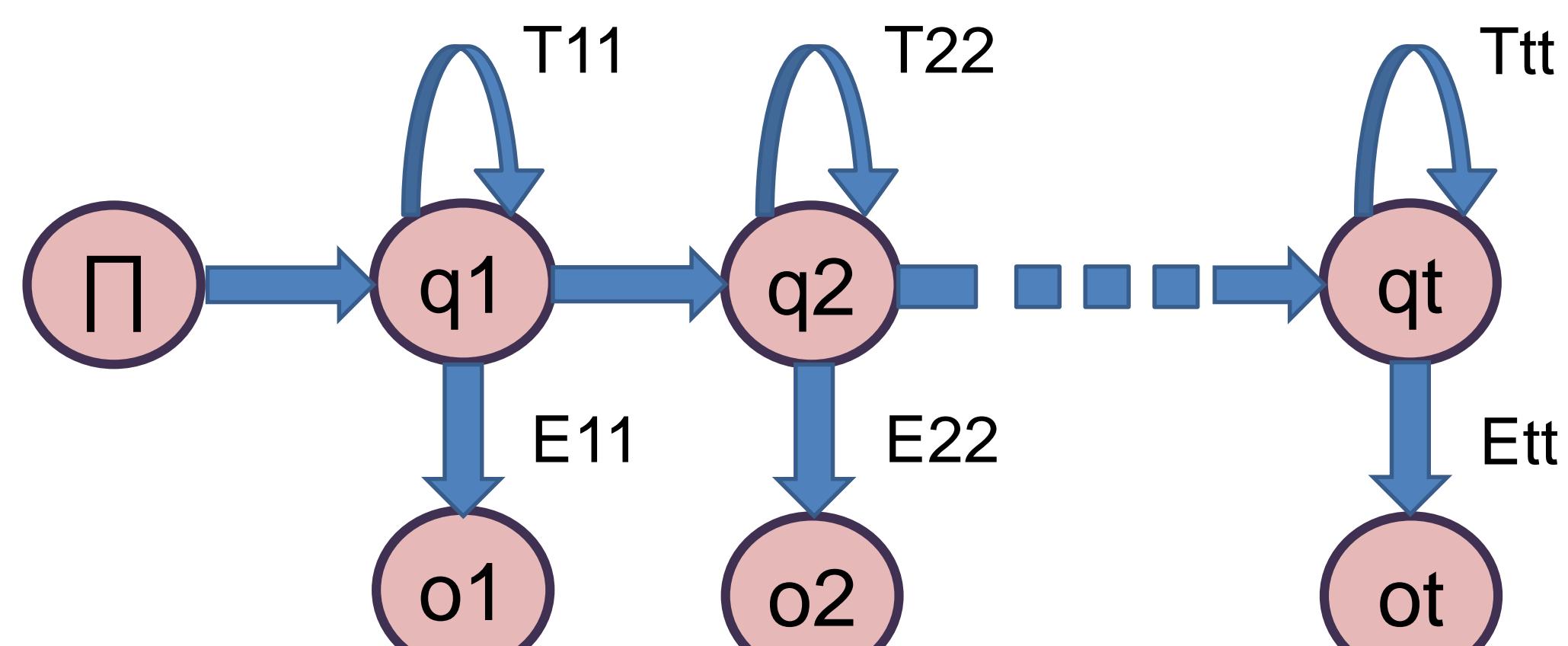


PROPOSED TECHNIQUE FOR MUSCLE ACTIVITY DETECTION



HMM TOPOLOGY

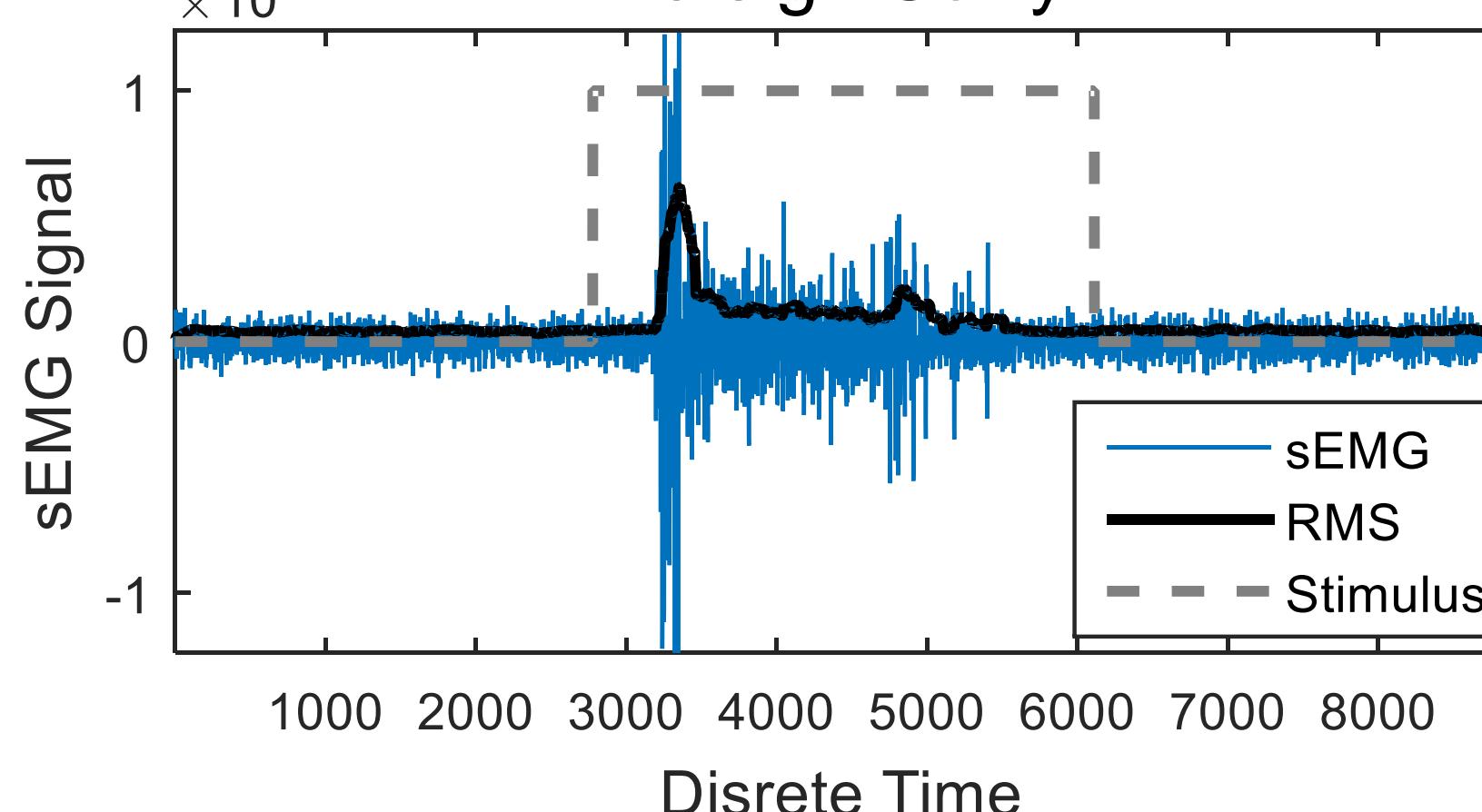
In an HMM, the states are unknown or *hidden*. These states are predicted on the basis of initial state, transition probabilities and observations obtained from the signal.



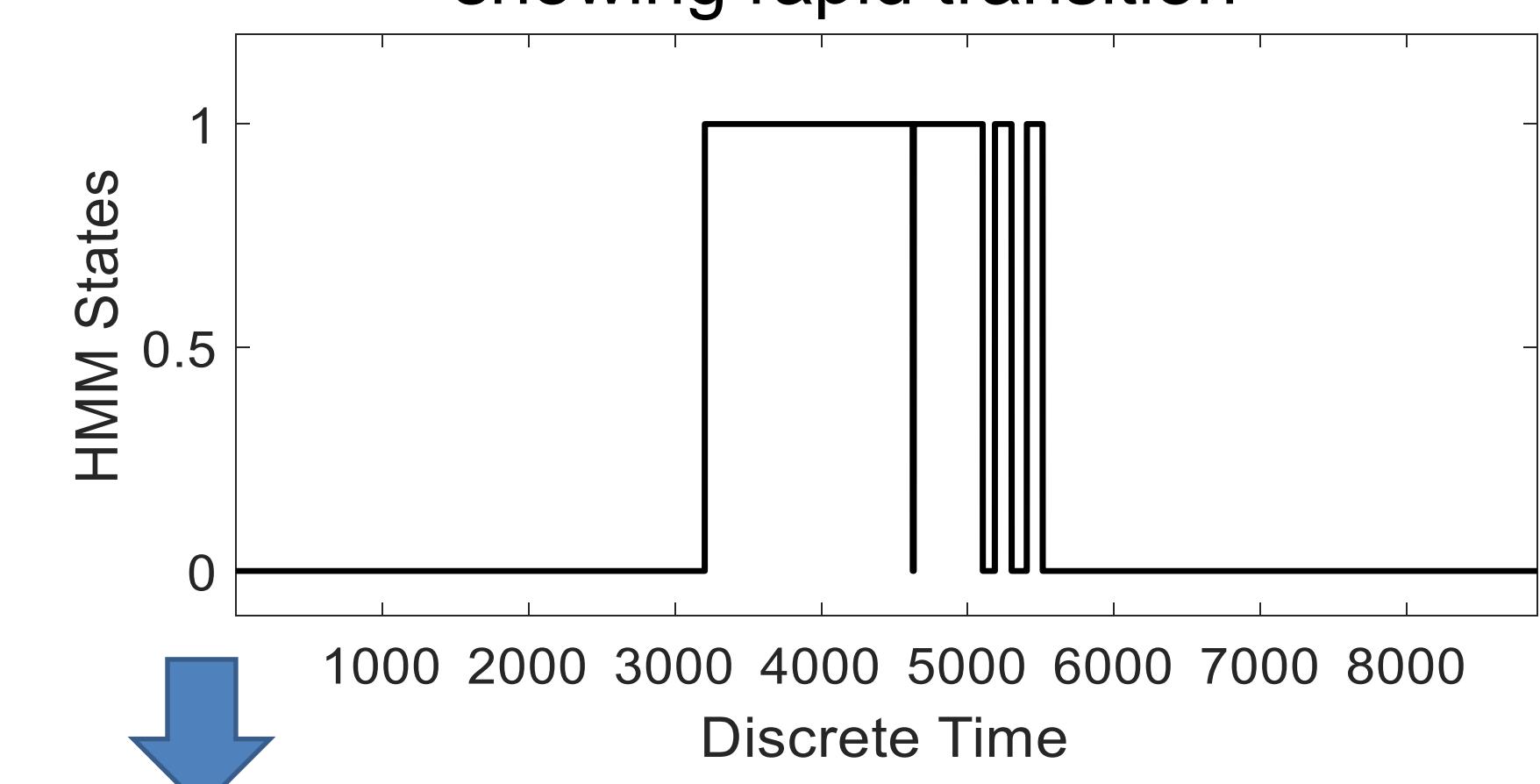
Hidden States, $Q = \{q_i\}, i = 1, 2, \dots, N$
Transition Probabilities, $T_{ij} = P(q_j \text{ at } t+1 | q_i \text{ at } t)$
Symbols, $O = \{o_k\}, k = 1, 2, \dots, M$
Emission Probabilities, $E_{ik} = P(o_k | q_i)$

RESULTS AND DISCUSSIONS

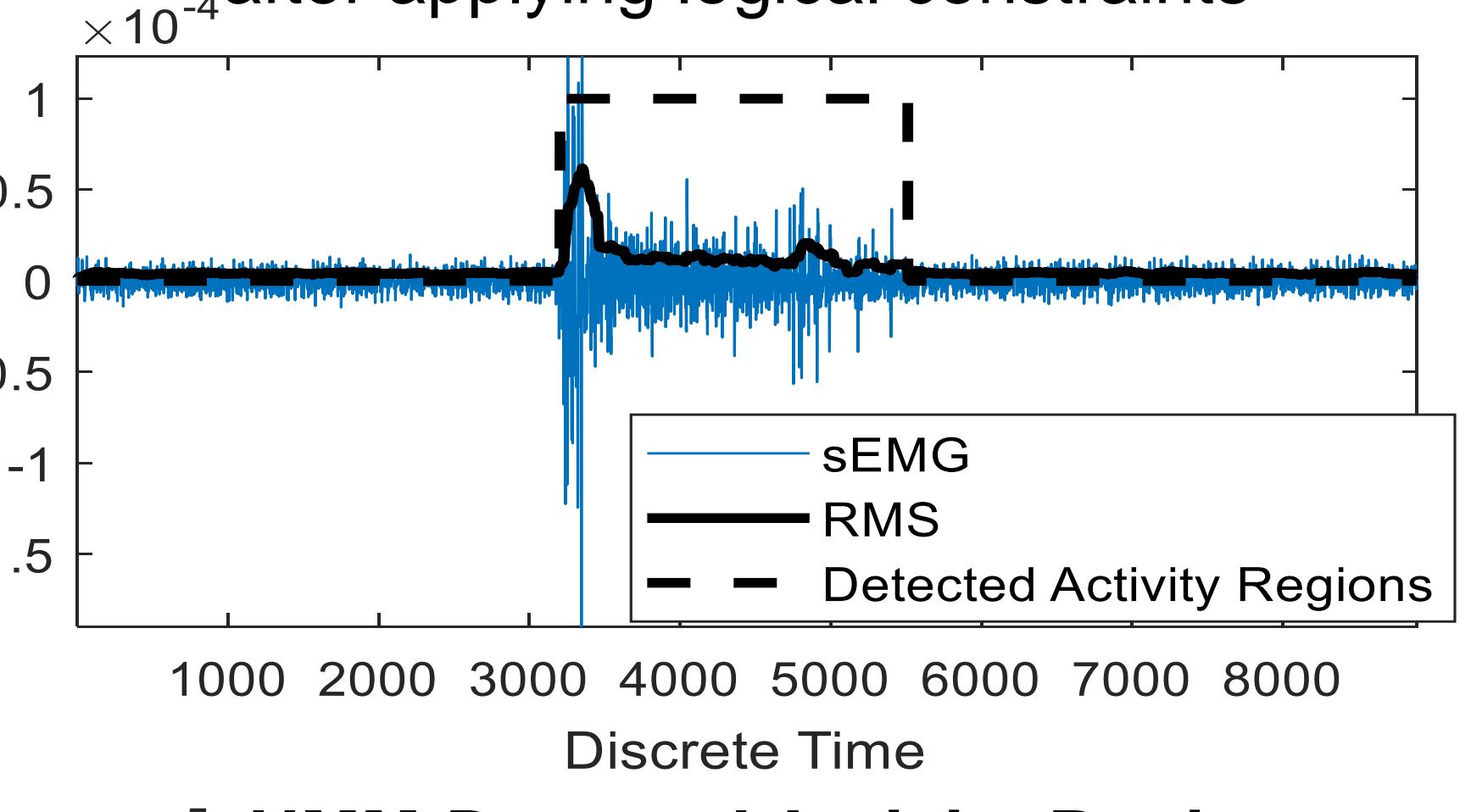
Stimulus overlaid on sEMG signal for the sign Sorry



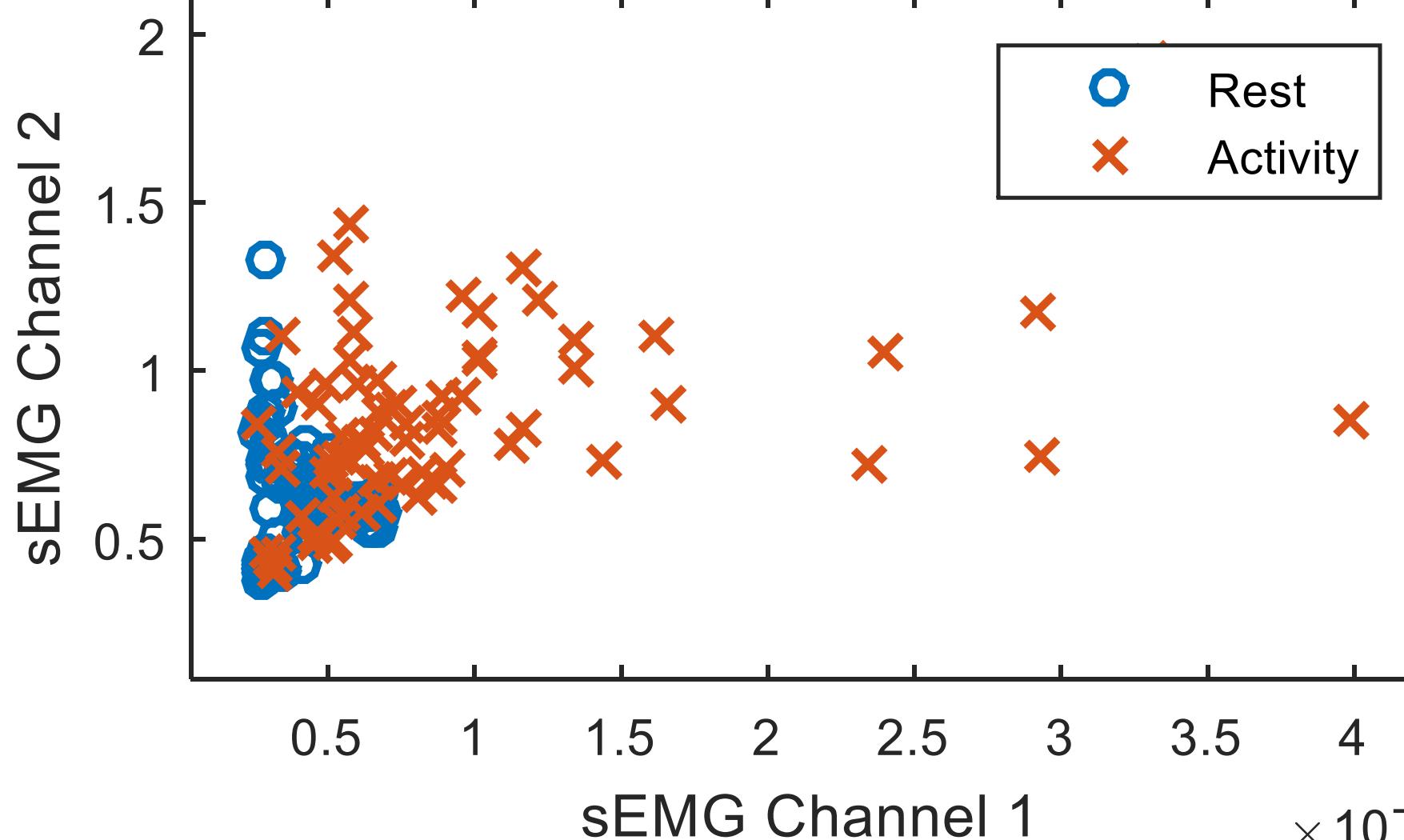
HMM Detected Activity Region showing rapid transition



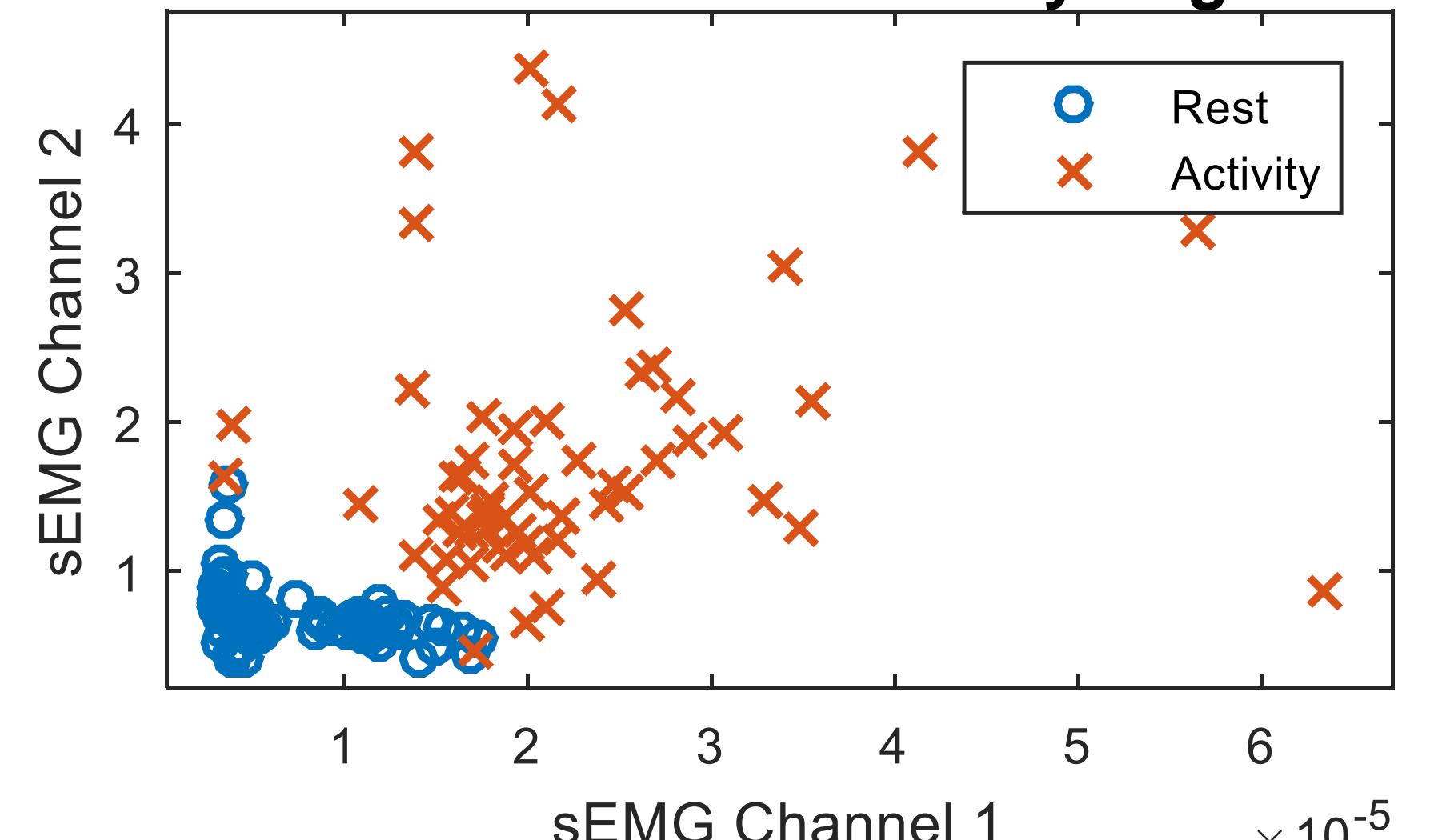
Detected activity region from HMM states after applying logical constraints



Stimulus based Activity Regions



HMM-Detected Activity Regions



REFERENCES

1. X. Zhang, X. Chen, Y. Li, V. Lantz, K. Wang, J. Yang, "A framework for hand gesture recognition based on accelerometer and EMG sensors," IEEE Trans Systems, Man, and Cybernetics-Part A: Systems and Humans, vol. 41, no. 6, pp. 1064-1076, 2011.
2. H. Veisi, H. Sameti, "Hidden-Markov-model-based voice activity detector with high speech detection rate for speech enhancement", IET Signal Processing, 17th April 2011.

Our Research paper: Rinki Gupta, Karush Suri, "Activity Detection from Wearable Electromyogram Sensors using Hidden Markov Model," *IEEE 2nd International Conference on Computing Methodologies and Communication (ICCMC)*, 15-16 Feb 2018, pp.1-6, 2018

Under the project sponsored by Science and Engineering Research Board ECR/2016/000637