

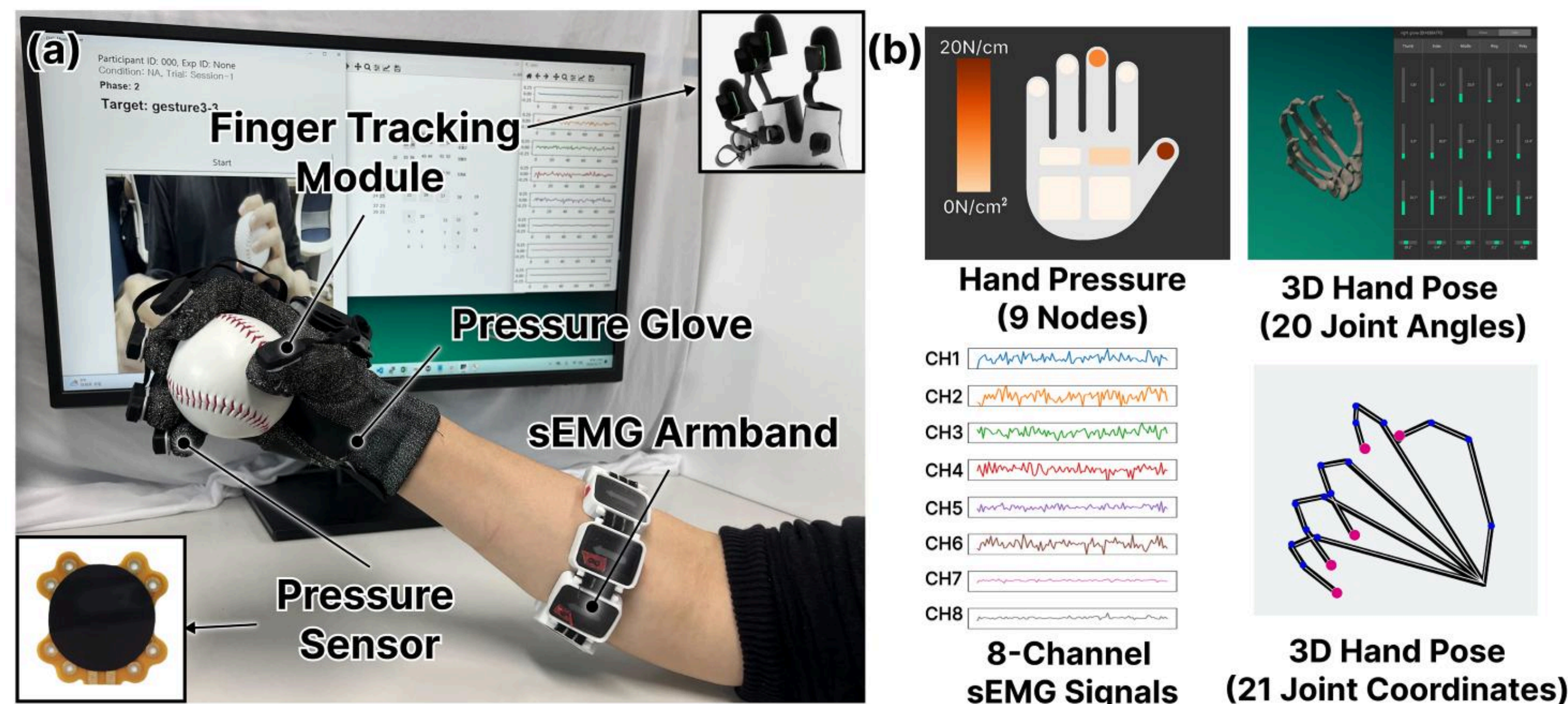
Posture-Informed Muscular Force Learning for Robust Hand Pressure Estimation

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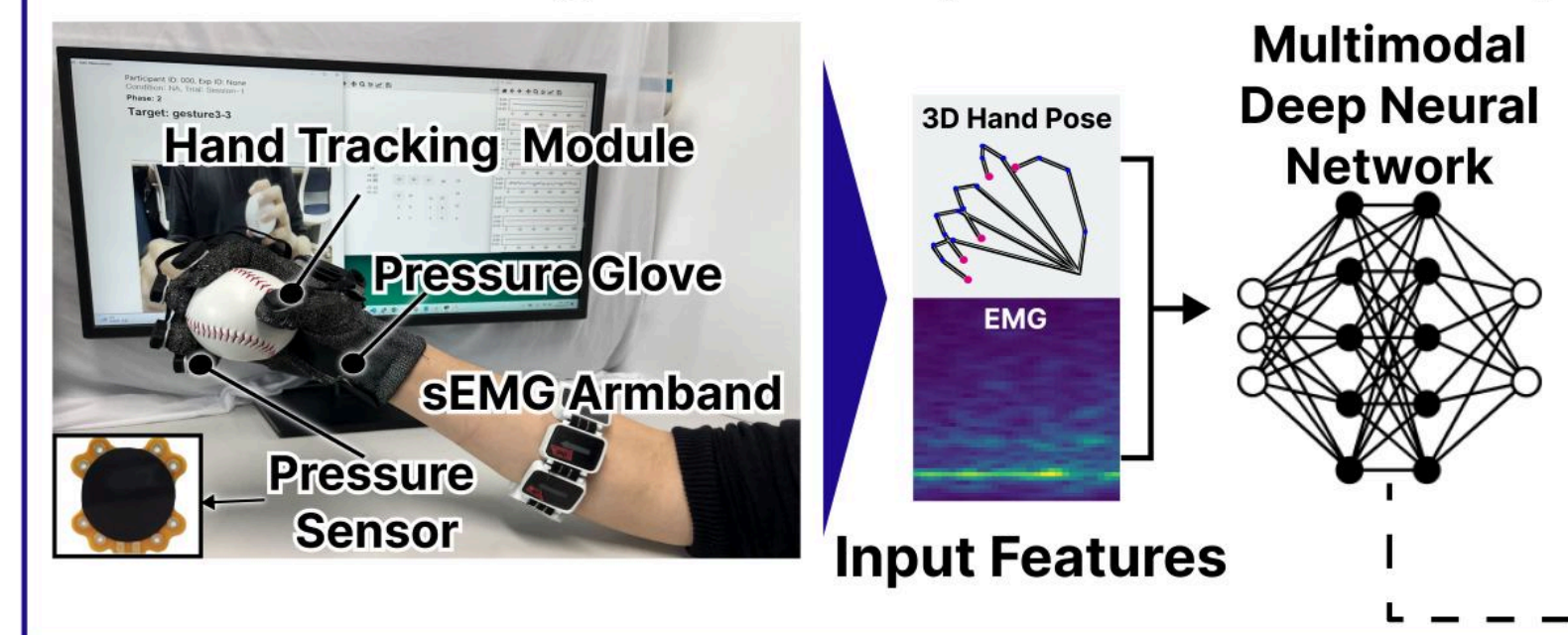
Building Multimodal Dataset

- Multi-modal data acquisition system consisting of **pressure glove**, **8ch EMG sensor armband**, and **hand tracking module**
- Collected 1980 seconds of synchronized multimodal data set of 22 hand gestures per participant
- A total of **21 right-handed participants**

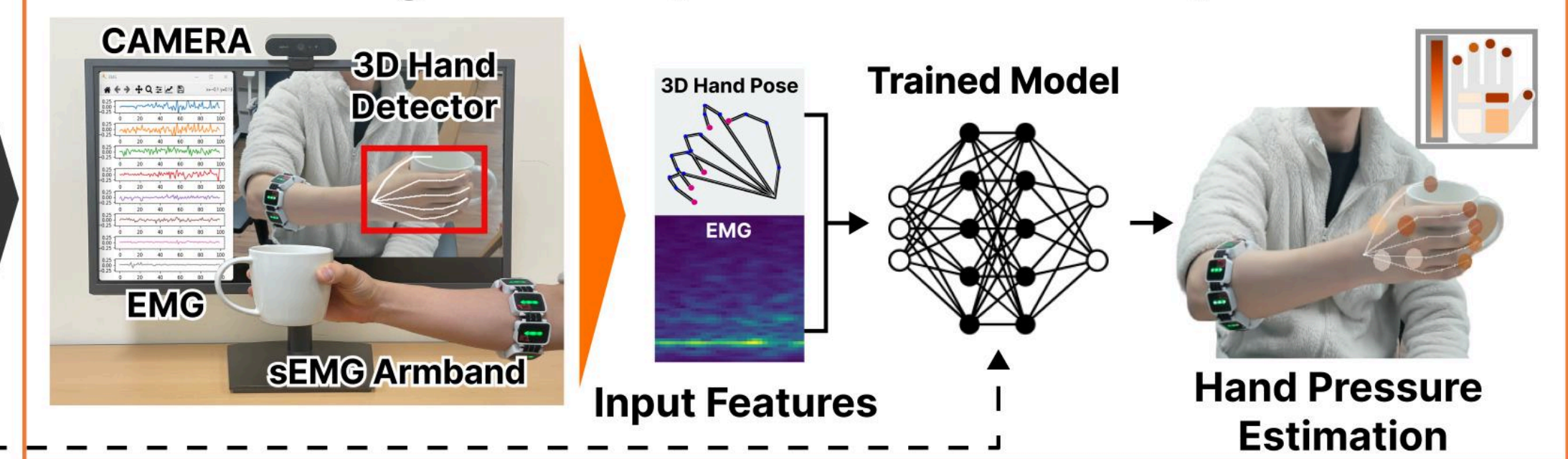


Hand Pressure Estimation Results

Model Training Session (with Data Glove)



Model Testing Session (without Data Glove)



- Performance among comparative models on evaluation metrics.

Method	R^2	NRMSE	Accuracy
sEMG Only [4]	$83.49 \pm 16.40\%$	$8.07 \pm 2.62\%$	$77.83 \pm 11.56\%$
3D Hand Posture Only	$66.32 \pm 37.01\%$	11.57 ± 3.95	$70.08 \pm 13.09\%$
sEMG + Hand Angles	$84.22 \pm 17.11\%$	$7.89 \pm 2.61\%$	$78.22 \pm 10.57\%$
PiMForce (Ours)	$88.86 \pm 11.92\%$	$6.65 \pm 2.11\%$	$83.17 \pm 9.38\%$

Method	R^2	NRMSE	Accuracy
PressureVision++ [17]	$40.30 \pm 5.14\%$	$32.95 \pm 2.02\%$	$67.90 \pm 3.01\%$
sEMG only [4]	$42.13 \pm 6.88\%$	$12.57 \pm 2.09\%$	$66.00 \pm 5.84\%$
PiMForce (Ours)	$66.71 \pm 4.68\%$	$9.27 \pm 1.40\%$	$82.20 \pm 2.42\%$

Model Architecture

- Enhance sEMG signals by leveraging 3D hand posture information
- Train the model using a **classification-regression joint loss** to improve hand pressure estimation.

