

Estimating Action Research Arm Test (ARAT) Scores Using Inertial Sensor Data

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0.27

Grasp (ARAT01)

0.24 0.15

Predicted ARAT Scores

Pinch (ARAT15)

Predicted ARAT Scores

Individual Exercise Prediction

0.4 10.0



Grip (ARAT09)

0.67 0.33

Predicted ARAT Scores

S 1 0.1 0.66 0.2 0.04

Predicted ARAT Scores

0.12 0.88

Outliers (> 3 SD)

Sample Size: 110

Background

Goals

Mitigate the clinician's work by using minimal resources to evaluate a stroke patient's upper limb function.

Accurately predict clinical ARAT scores given IMU sensor data from a single exercise in each subcategory.

ARAT

- 19 Exercises
- Scored 0-3
- 4 Subcategories



6 Grasp



4 Grip

Dataset

P2C is part of the C-STAR Data Sharing project.

It contains clinical and IMU sensor data taken during various tests, including the ARAT.







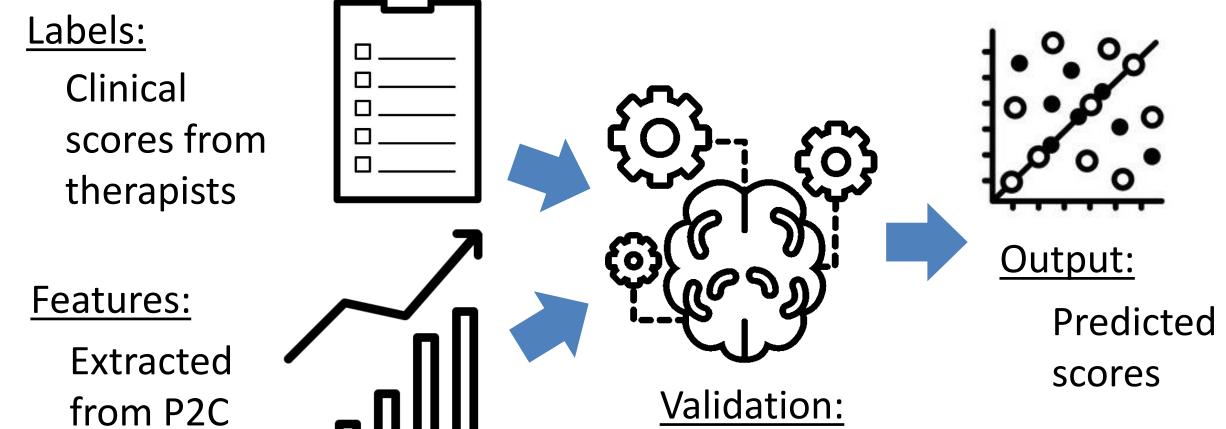
Participant Type: Stroke

Mean Total Score: 24.8 / 57

Age (Mean, SD): 61 ± 10 years

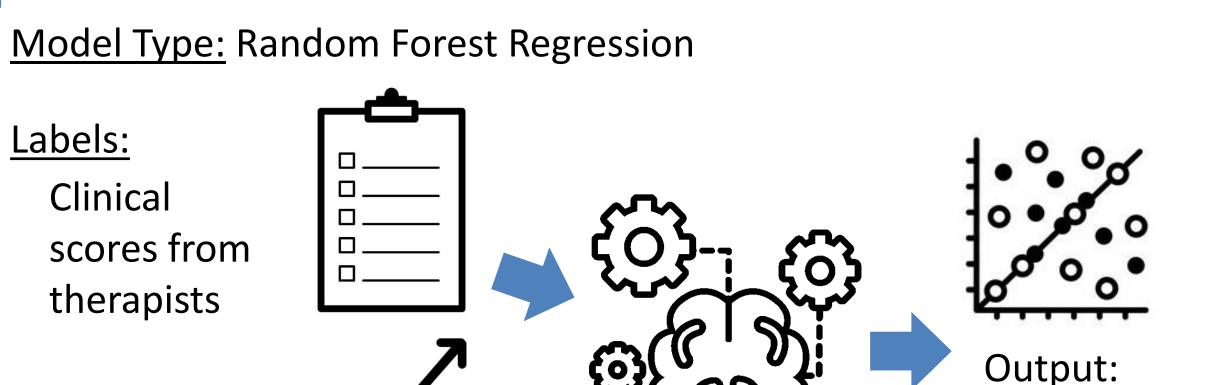
Model Framework

Specifications



Features

75th%, kurtosis, signal magnitude area, absolute range, tilt angle Frequency Domain: Spectral energy/entropy/centroid, principal

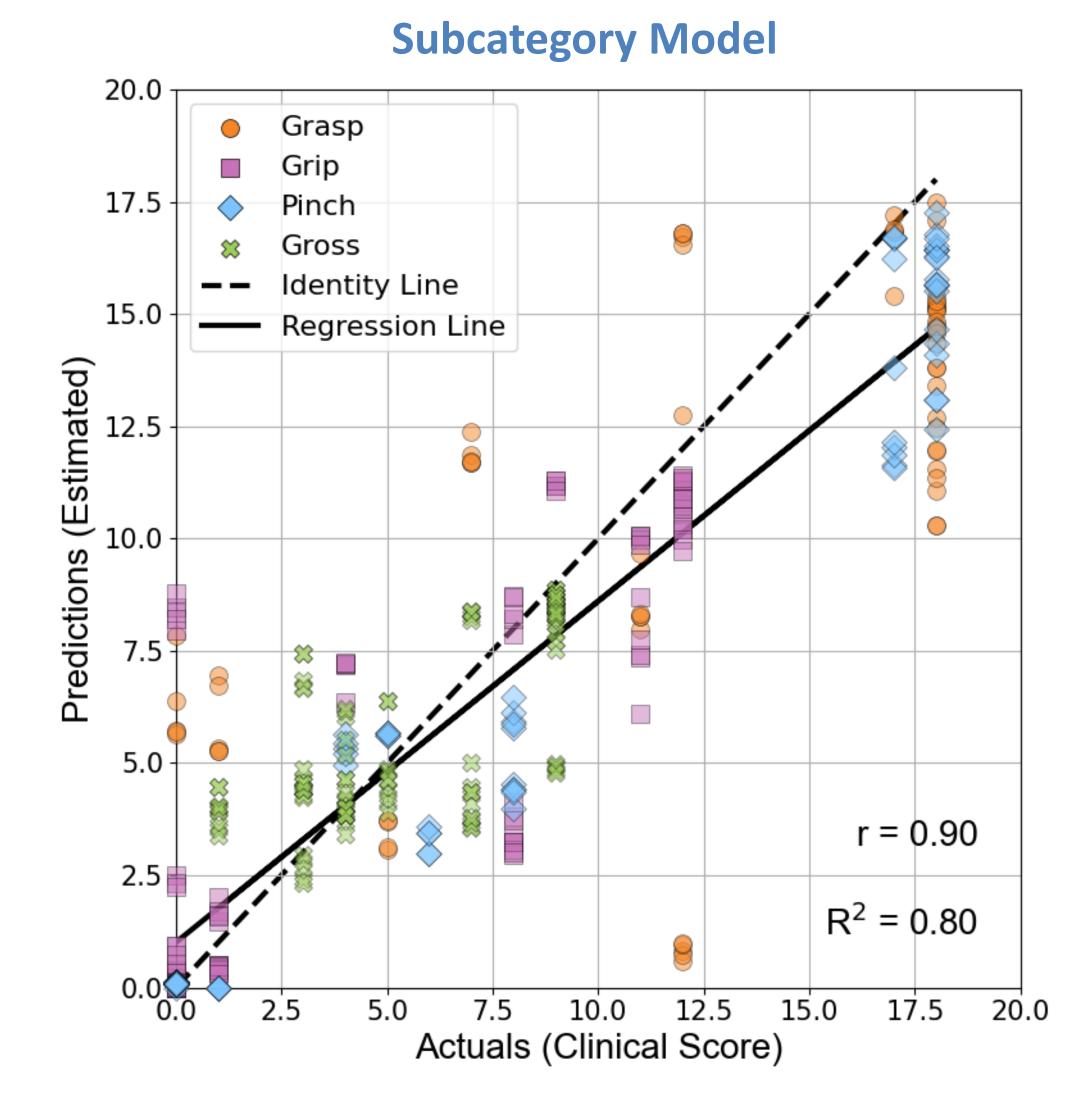


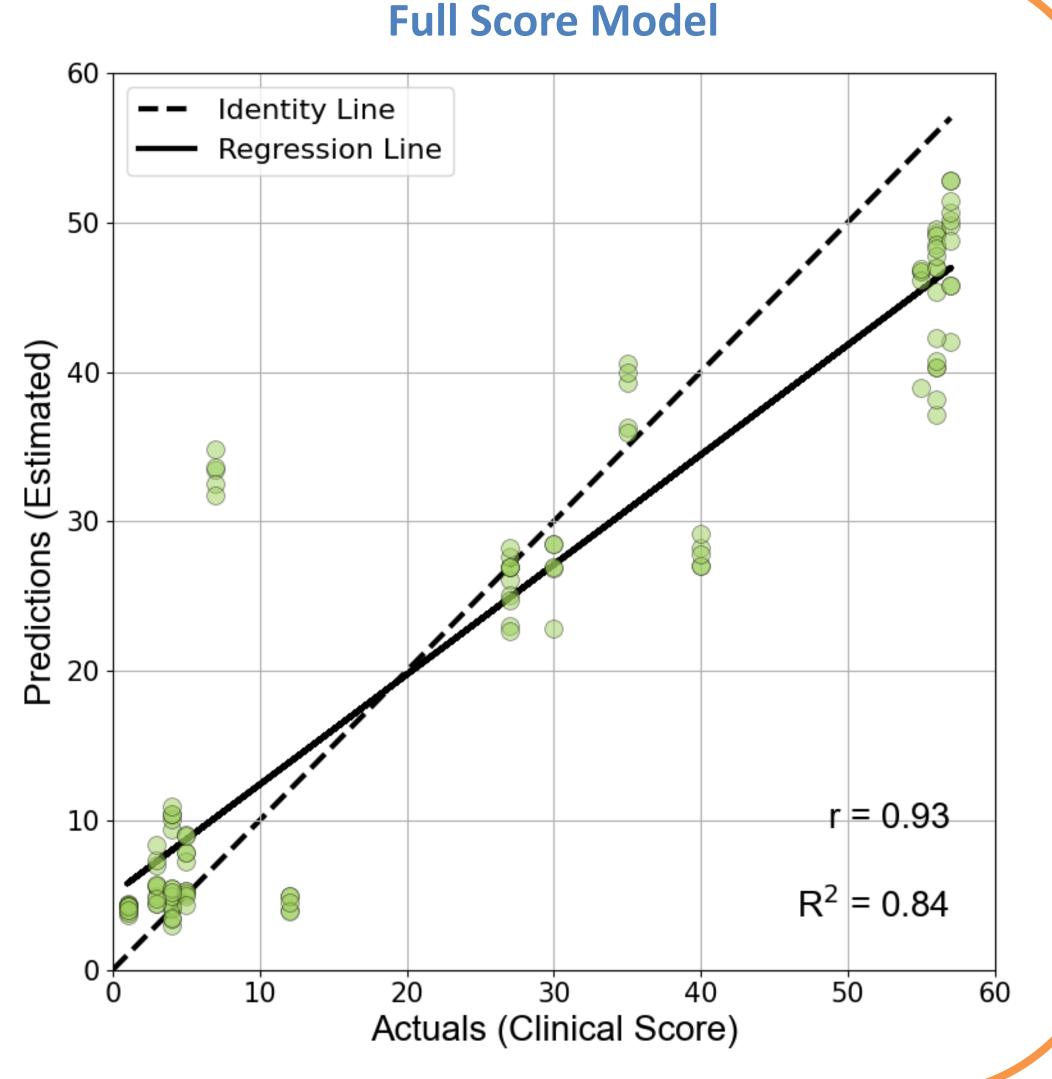
Repeated K-Fold + LOSO dataset

<u>Time Domain:</u> Mean, variance, MAD, RMS, zero-crossing rate, IQR, frequency

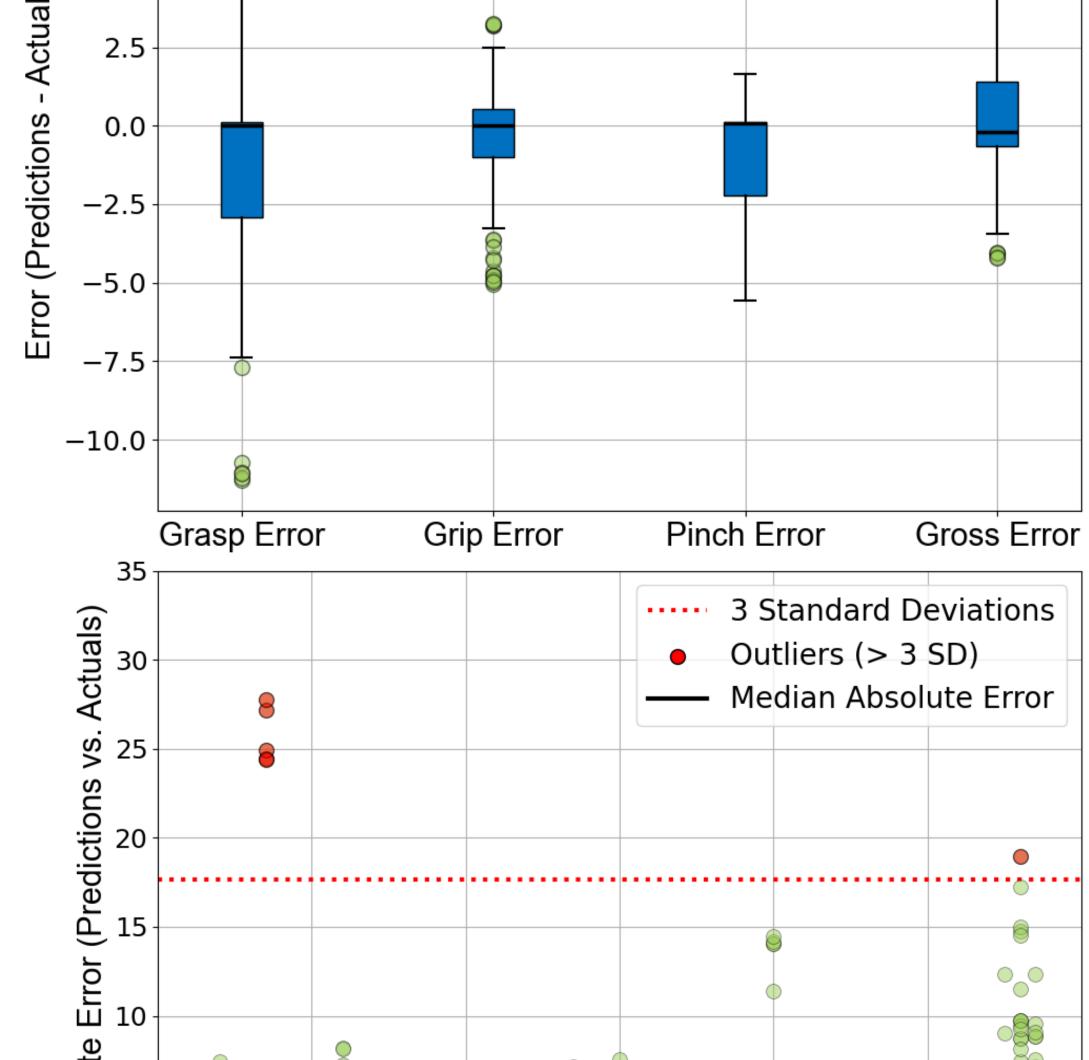
Full Score Prediction

Metric	Subcat	Full
MAE	1.78	6.30
MedAE	0.93	4.23
RMSE	2.79	8.84
ſ	0.90	0.93
R ²	0.80	0.84





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Model Performance

Future Work

Potential Improvements

- Improve data/featureset Hyperparameter tuning Interface + ease of use

Abbreviations

LOSO: Leave one subject out IQR: Interquartile range MAE: Mean absolute error RMSE: Root mean squared error R²: Coefficient of determination

MAD: Mean absolute deviation RMS: Root mean square MedAE: Median absolute error <u>r:</u> Correlation coefficient SD: Standard deviation

References:

Werner et al (2022). Using wearable inertial sensors to estimate clinical scores of upper limb movement quality in stroke. Frontiers in Physiology

2. Grattan et al (2019). Interpreting Action Research Arm Test assessment scores to plan treatment. Occupational Therapy Journal of Research

Actuals (Clinical Score)