**BiGRA: A Preliminary Bilateral Hand Grip Coordination Rehabilitation Using Home-Based Evaluation System for Stroke Patients**

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**Introduction**

Currently, individuals with stroke are responsible for self-managing their rehabilitation once therapist guided rehabilitation has concluded. Individuals with stroke are often required to perform daily routines such as cooking or dressing, which are challenging due to decreased motor function. The present study introduces a novel system to more effectively facilitate in-home bilateral Rehabilitation. This system holds merits in:

- An end-to-end task-oriented system for bilateral grip control, which emphasizes the modulation of grip coordination between hands.
- Innovative metrics framework to quantitatively analyze the motor control performance.

**Methods**

**BiGRA Hardware System** (Fig. 1): Serve as the data acquisition unit for the whole system:
- Grip force sensor: Hand dynamometer from Vernier HD-BTA.
- Acer E5-571 and Surface Pro 4: to display the program and interact with the hand grip sensor.

**BiGRA Software System** (Fig. 3 and 4): Serve as the user interface and the data collection component of the whole system:
- Old version: Programmed in LabVIEW with low home-used compatibility but suitable for preliminary study.
- New version: Programmed in Python with more customization and more user-friendliness.

**Protocol**

- Approved with IRB: 030 - 645489.
- 18 participants from three groups: young adults (YA), older adults (OA), and adults with stroke (AS).

<table>
<thead>
<tr>
<th>TABLE 1: Demographic table for recruited participants.</th>
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<tbody>
<tr>
<td>AS</td>
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<tr>
<td>N</td>
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<tr>
<td>Age</td>
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<tr>
<td>Gender</td>
</tr>
<tr>
<td>Female</td>
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<tr>
<td>Max grip (kg)</td>
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<td>Left</td>
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**Quantitative Indices Framework: A Closer Look**

- **Completion time**: This is the time that each participant took to complete each trial.
- **Trajectory stability**: We obtain an optimal, smoothed trajectory that has the best fit with all the data points by fitting a polynomial curve

$$h(X) = \sum_{i=1}^{n} \sum_{j=1}^{m} c_{ij} X_{ij}$$

- **Stability (S\(_t\)) score**: It is the minimized value of the cost function of the polynomial regression.

$$S_t = \min(F) = \min \left( \sum \left( h(X_i) - Y_i \right)^2 \right)$$

**Conclusion**

The evaluation shows that BiGRA can objectively measure the patients’ task performance and is a promising assessment tool for stroke rehabilitation.