

Round 2: Response to Reviewer 3 Comments

Thank you for acknowledging the revisions and for providing further constructive comments. We agree that the manuscript has notably improved, and we will carefully address the remaining concerns point by point in the following response.

Comment 1:

Deep-brain stimulation has been mentioned, but a couple of references should be added when speaking about the invasiveness of DBS (e.g., <https://doi.org/10.3390/med7030084>, <https://doi.org/10.1016/j.wneu.2023.07.103>). Moreover, the brief insight about the MRI-based diagnosis of PD, which can be directly added in the same paragraph, still lacks in the Introduction.

Response 1:

We thank the reviewer for the valuable suggestion. We would like to note that advanced MRI-based diagnostic approaches, including diffusion tensor imaging, neuromelanin-sensitive MRI, and iron-sensitive sequences, are already mentioned at the beginning of the Introduction (Lines 80-83). This early mention aims to provide context on current neuroimaging efforts for early detection of PD. In addition, we have incorporated the suggested references to further enhance the discussion of DBS and MRI-based diagnostics within the same paragraph (Lines 175-177).

Comment 2:

The sentence "These clinical manifestations [...] mobility, balance, and independence in daily life" could be extended by mentioning a couple of studies about PD rehabilitation, otherwise it would be perceived as out-of-context.

Response 2:

We thank the reviewer for the suggestion to contextualize the clinical relevance of PD symptoms with evidence from rehabilitation studies. We have now extended the sentence to include references to recent studies demonstrating that structured rehabilitation interventions can effectively improve mobility, balance, and independence in daily life for people with Parkinson's disease (Lines 90-92)

Comment 3:

The sentences "optical motion captures [...] for wider clinical application" need to be written in such a way as to strongerly justify the choice of a fixed motion capture system within the proposed framework, since the drawbacks of illumination independence, occlusion, and portability have not been adequately supported by reference yet (e.g., <https://www.mdpi.com/1424-8220/25/1/260>, https://doi.org/10.1007/978-3-030-01845-0_224, 10.1109/LRA.2019.2928775).

Response 3:

We thank the reviewer for this helpful comment. We have revised the Introduction to clarify our rationale for using fixed optical motion capture, including additional references (Lines 148-162). We also acknowledge in the Limitations section that optical motion capture is resource-intensive and lacks portability, and highlight that future work will validate identified features using wearable technologies for broader clinical application (Lines 1211-1218).

Comment 4:

At least one paragraph clearly highlighting the paucity in the literature that is filled by the presented study, and the novelty of this latter should be added.

Response 4:

We thank the reviewer for the comment. A paragraph has been added highlighting the lack of standardized, multidimensional tools for capturing fine-grained functional mobility impairments in PwP and emphasizing the novelty of the FMA-P, which integrates motion capture, a pressure-sensitive gait mat, and observational metrics to differentiate PwP from controls and monitor changes over time (Lines 192-197 & Lines 208-211).

Comment 5:

Even though it is clear that turning actions entail clockwise and counterclockwise directions, a brief mention to their possible impact on the results and how they have been treated in the processing should be included, since the sign of the signal from a motion tracking system would be different, thus modifying the value of the related features. In fact, this "directional issue" has already been explored in other studies with kinematic data feeding Deep Learning architectures, since they directly influence of the features extracted from the processed data.

Response 5:

We thank the reviewer for this comment. The suggested clarification regarding turn direction has been incorporated in the manuscript (Lines 357-360). All turning-related measures were normalized or sign-adjusted during data processing to ensure comparability across clockwise and counterclockwise turns.

Comment 6:

Since 7 of the 12 participants recruited in Study 2 are different from the ones recruited in Study 1, were these different groups matched by characteristics?

Response 6:

We thank the reviewer for this comment and have addressed this concern in the manuscript (Lines 721-723). All participants in Study 2 were assessed under the same experimental conditions and recruited based on the same inclusion criteria as Study 1, ensuring comparable clinical characteristics at a group level.

Comment 7:

Study limitations should be supported by a couple of references, if possible.

Response 7:

We thank the reviewer for the comment. As suggested, we have added references to support the study limitations.

Comment 8:

Tables should be enhanced to be "aesthetically worth" of a scientific paper (suggested appearance: Table 1 of <https://doi.org/10.3390/s25010260>)

Response 8:

We thank the reviewer for the comment. We have revised and enhanced all tables to improve their clarity and scientific presentation.

Comment 9:

Figure 8 merged images in a single panel, but this could be arranged horizontally to reduce the space occupation.

Response 9:

We have revised Figure 8 so that the merged images are now arranged horizontally, reducing the space they occupy.