Reliability Project Update - Correlating Shape Parameter Value with Magnitude of Mesh Movement
October 8th - Emma Young

The neutral version of the SMPL body model [1] was used to randomly generate 1,000 people to mimic the distribution of bodily features seen in the AMASS dataset [2]. This was done by randomly generating a number between -6 and 6 for each of the parameters that control the shape of the body. This process of selecting numbers allows us to more easily visualize the correlation between shape parameter value, and magnitude of nodal movement. More extreme nodal movement is captured in outlier shape parameter values.

Two pieces of information are stored after a person is generated: the value of their shape parameters, and the distance each node on the mesh has moved from the default mesh position (Figure A).

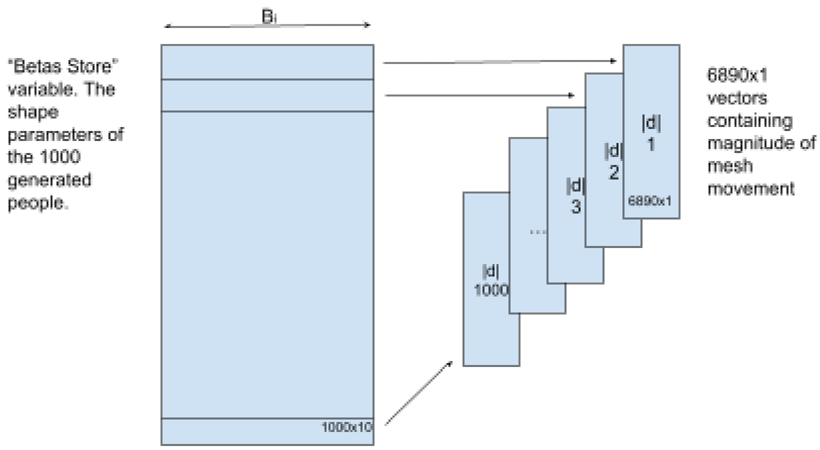

Figure A: The creation of the data used in the correlation matrix.

This is combined to create a correlation matrix where only the correlations between shape parameters and nodal movements are considered (Figure B).

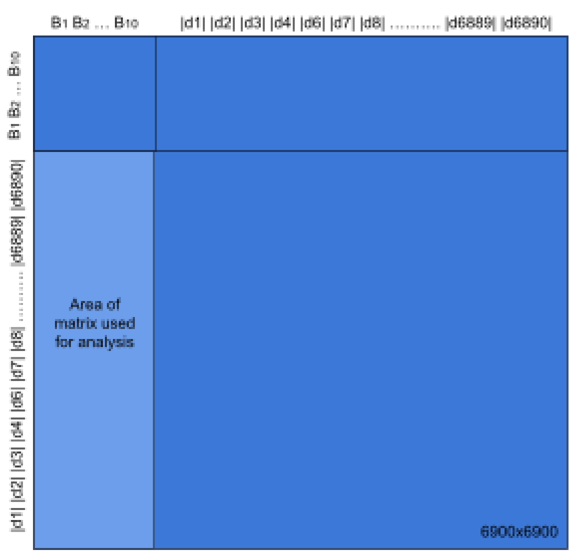

Figure B: The total correlation matrix and the segments used for analysis

These correlations can be visualized on the default neutral mesh to understand which areas of the body are controlled by each shape parameter (Figures 1-10). A heatmap has been created for each shape parameter. To read and understand these graphs fully, one must pay special attention to the colorbar legend. This shows the range in correlation across the entire mesh for a particular shape parameter. The darkest red is associated with the highest positive correlation between shape parameter and node movement, and the darkest blue is associated with the lowest correlation. Usually the colorbar indicates both positive and negative correlations. This means we can identify areas influenced by increasing the parameter (red) and areas influenced by decreasing the parameter (blue). Unfortunately, only the magnitude of mesh movement is known, not the direction.

We are also able to gauge how important each parameter is in controlling the mesh by observing how strongly it is correlated with mesh movement. The first shape parameter has the highest correlation with mesh movement, and this correlation decreases with each parameter. The maximum correlation for parameters 8, 9, and 10 all hover around 0.1. A natural next step is to let this inform decisions about which parameters are used in an optimization to control the SMPL mesh. The optimization could be simplified by using less shape parameters.

References

[1] Loper, M., Mahmood, N., Romero, J., Pons-Moll, G., & Black, M. J. (2015). SMPL. *ACM Transactions on Graphics*, *34*(6), 1–16. https://doi.org/10.1145/2816795.2818013

[2] Mahmood, N., Ghorbani, N., Troje, N. F., Pons-Moll, G., & Black, M. (2019). AMASS: Archive of Motion Capture As Surface Shapes. *2019 IEEE/CVF International Conference on Computer Vision (ICCV)*. https://doi.org/10.1109/iccv.2019.00554

Appendix - Figures

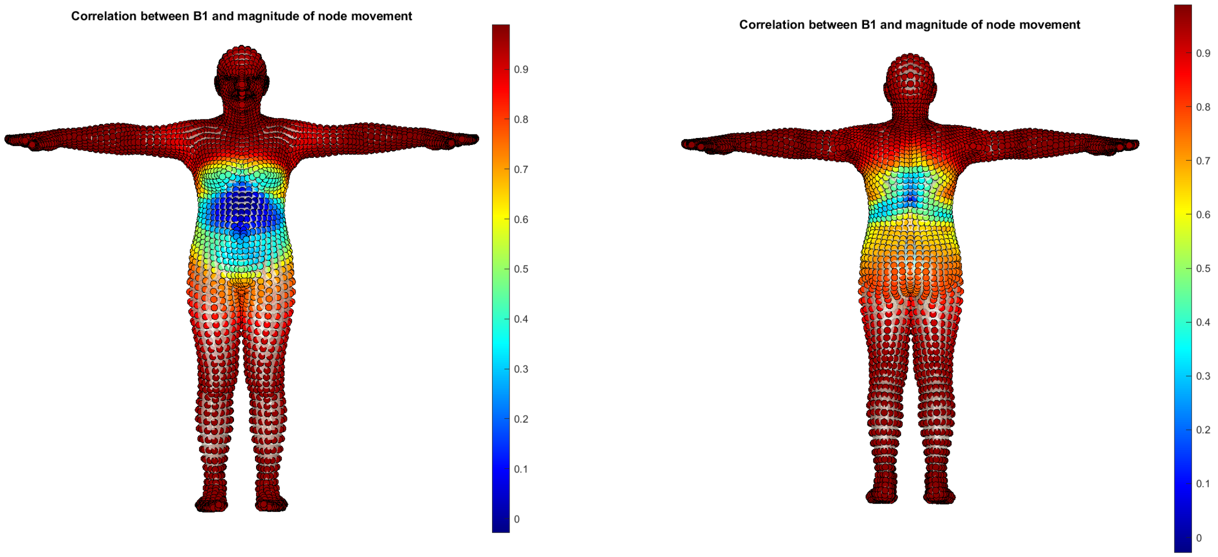

Figure 1: Correlation between β_1 and magnitude of node movement

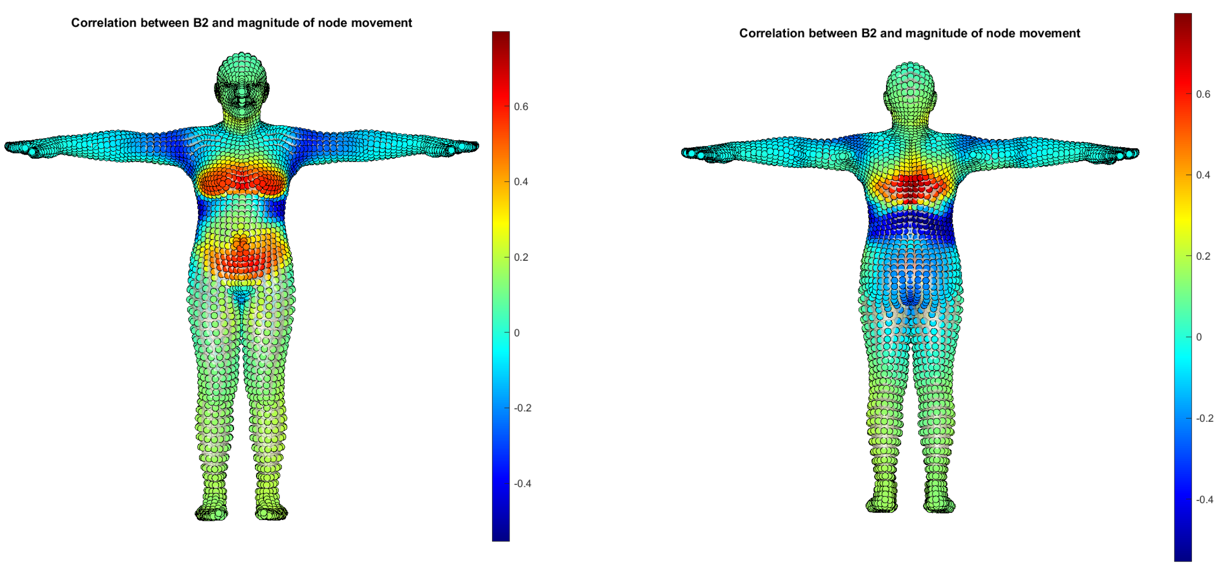

Figure 2: Correlation between β_2 and magnitude of node movement

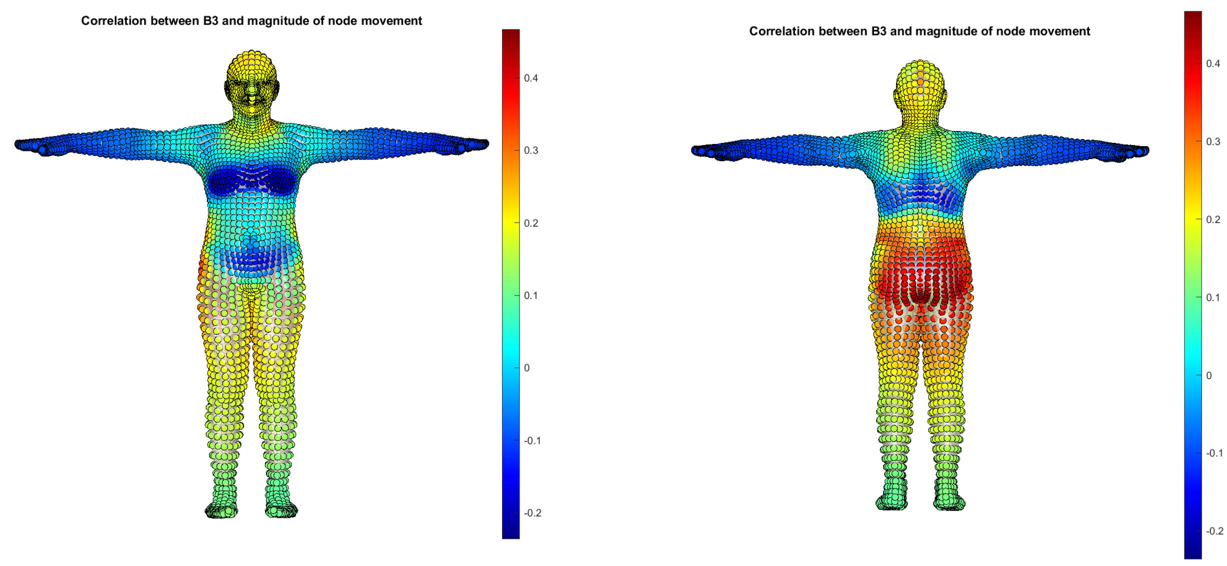

Figure 3: Correlation between β_3 and magnitude of node movement

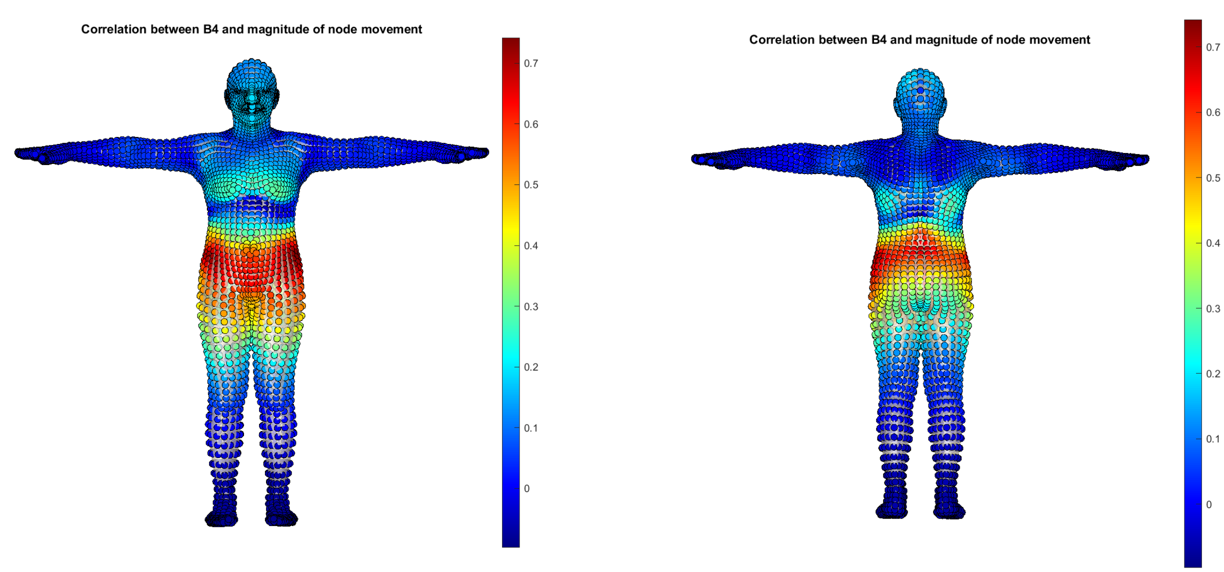

Figure 4: Correlation between β_4 and magnitude of node movement

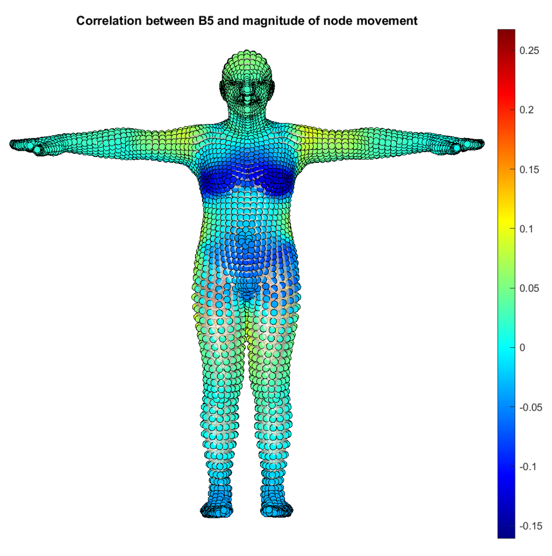

Figure 5: Correlation between β_5 and magnitude of node movement

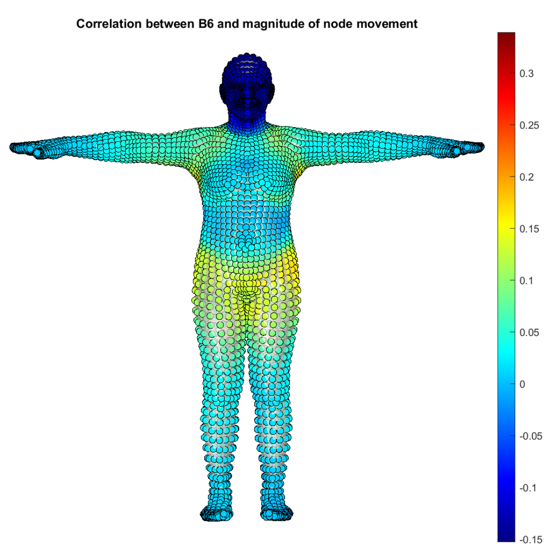

Figure 6: Correlation between β_6 and magnitude of node movement

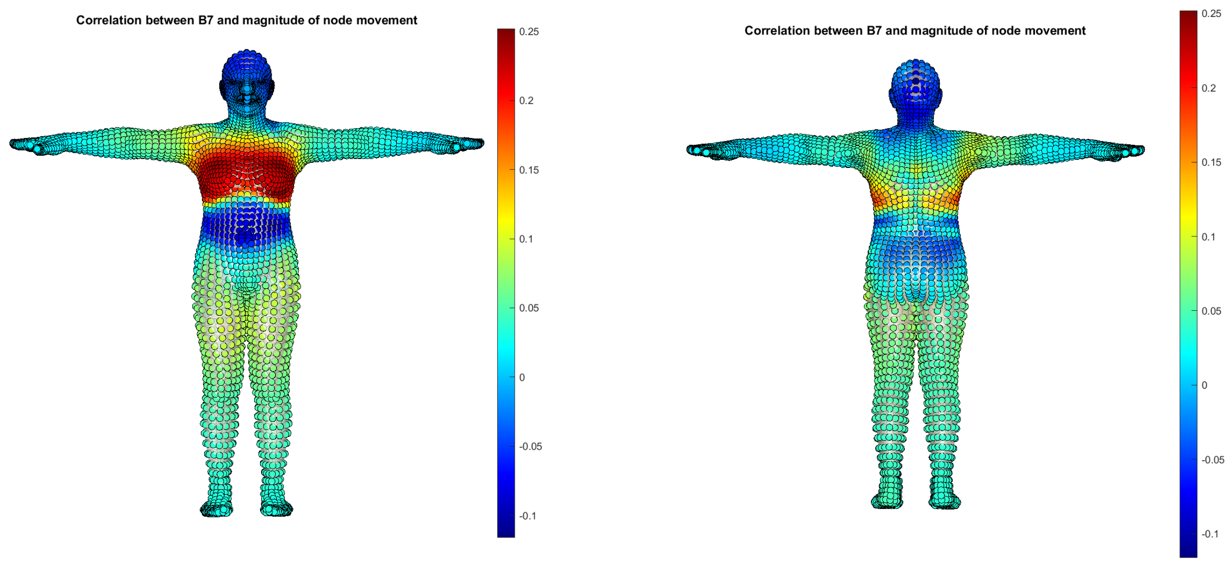

Figure 7: Correlation between β_7 and magnitude of node movement

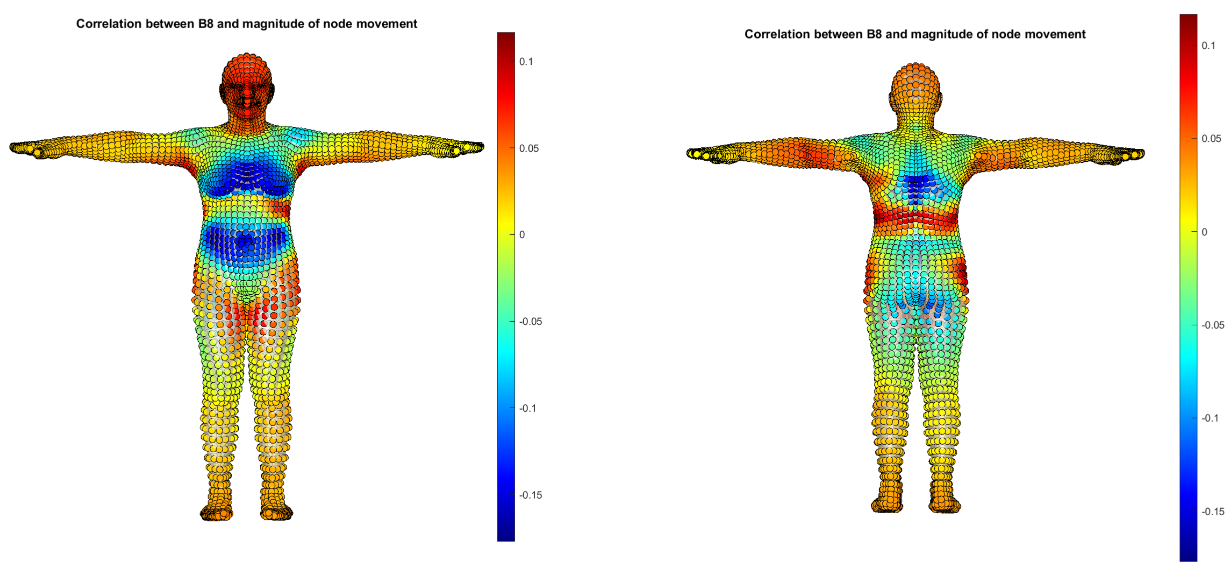

Figure 8: Correlation between β_8 and magnitude of node movement

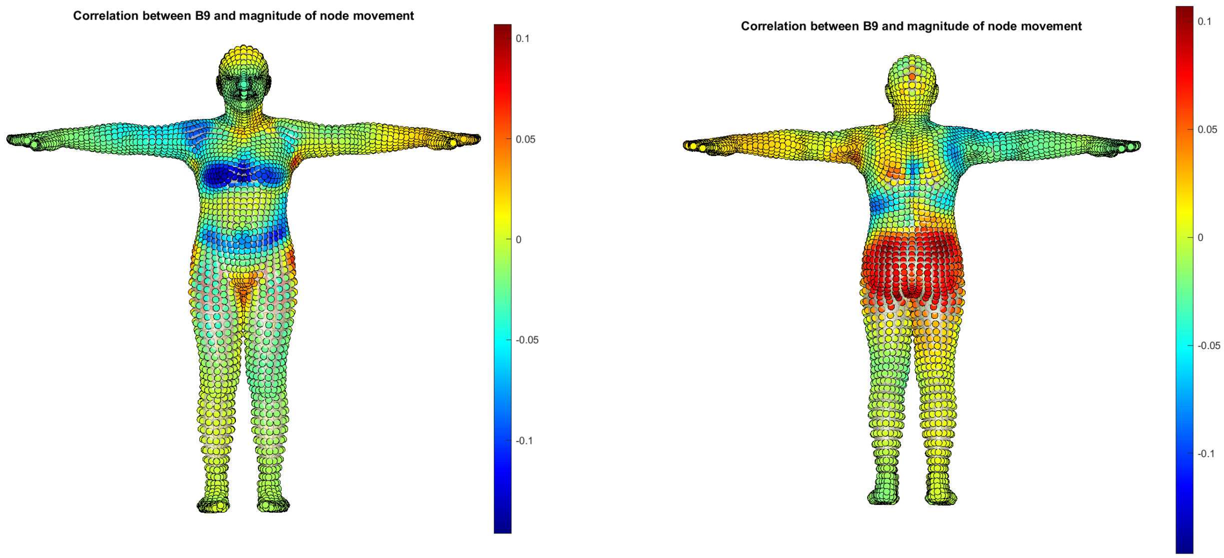

Figure 9: Correlation between β_9 and magnitude of node movement

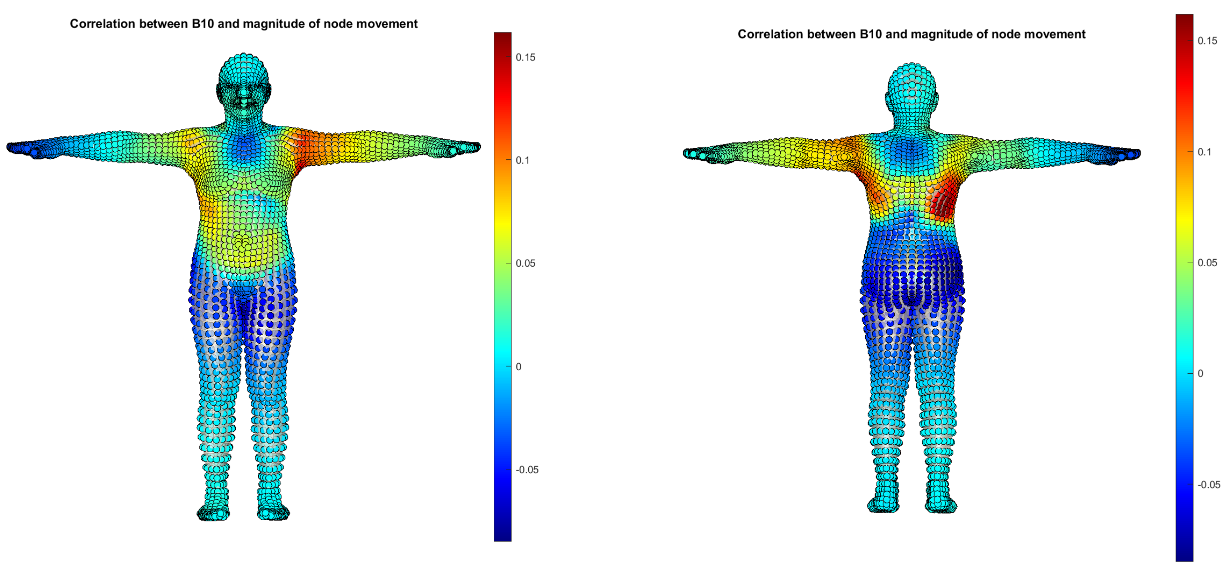

Figure 10: Correlation between β_{10} and magnitude of node movement