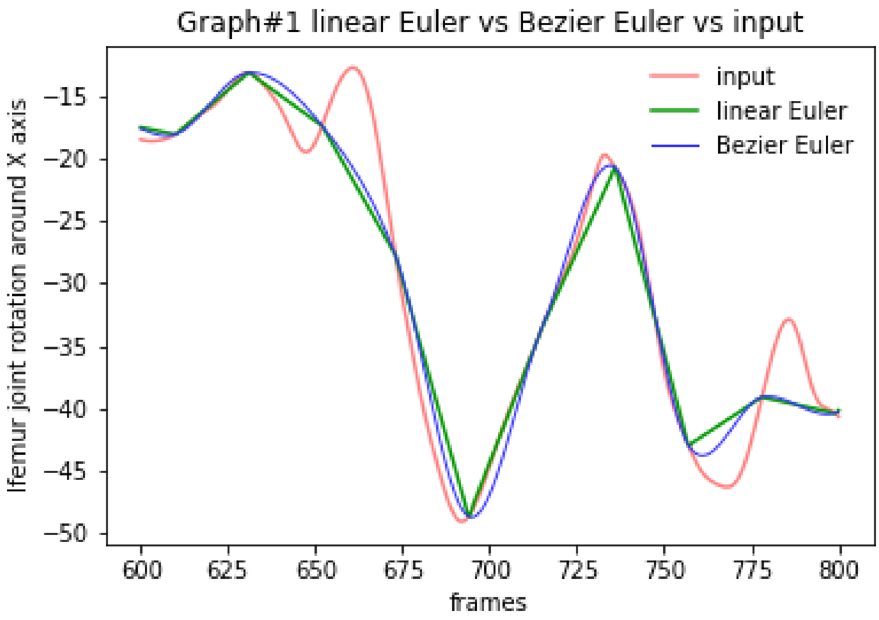
Findings And Observations

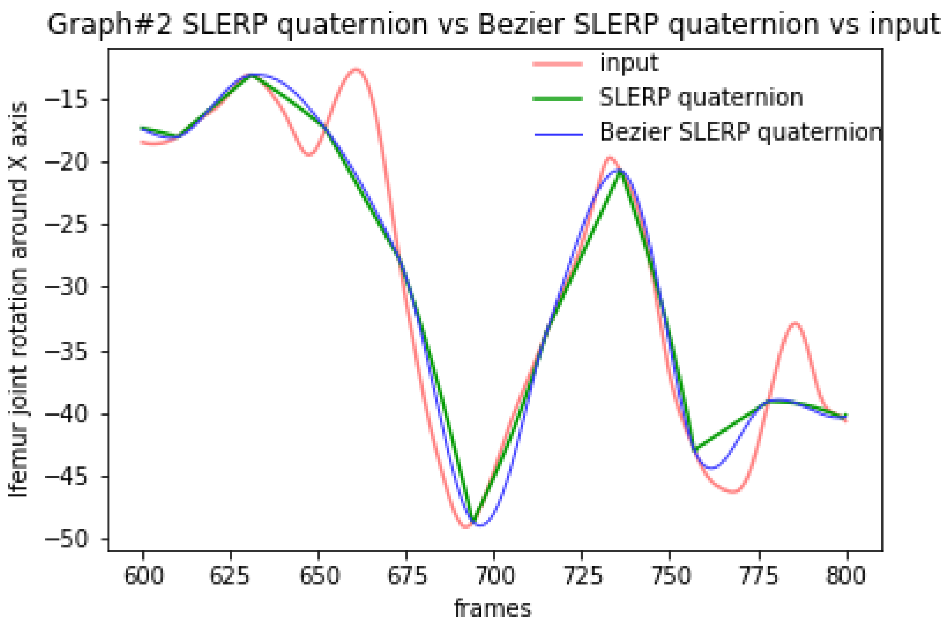
The following four graphs compare the performances of four different interpolation techniques when interpolating human motion data obtained from an optical mocap system.

Graph 1 and graph 2 show the results for lfemur joint, rotation around X axis, frame 600-800, for N=20, for 131_04-dance.amc input file.

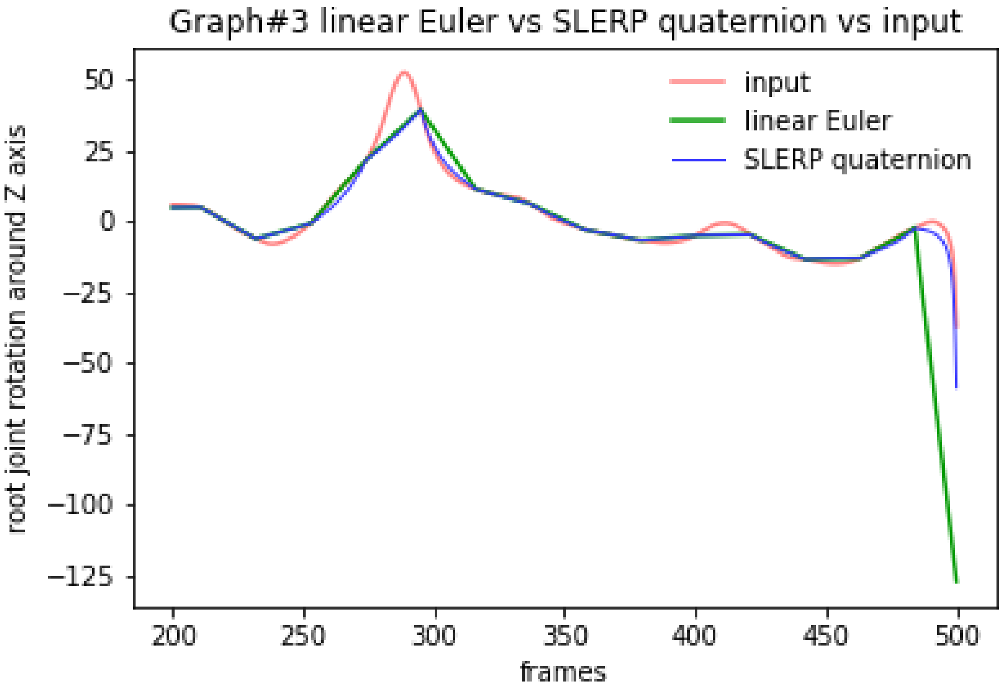


Graph#1 compares the results obtained when using Euler angles to interpolate keyframes with different approaches. Linear interpolation (shown in green) produces nearly straight lines between keyframes, while Bezier interpolation (shown in blue) results in smoother lines that follow the input (shown in red) more closely.

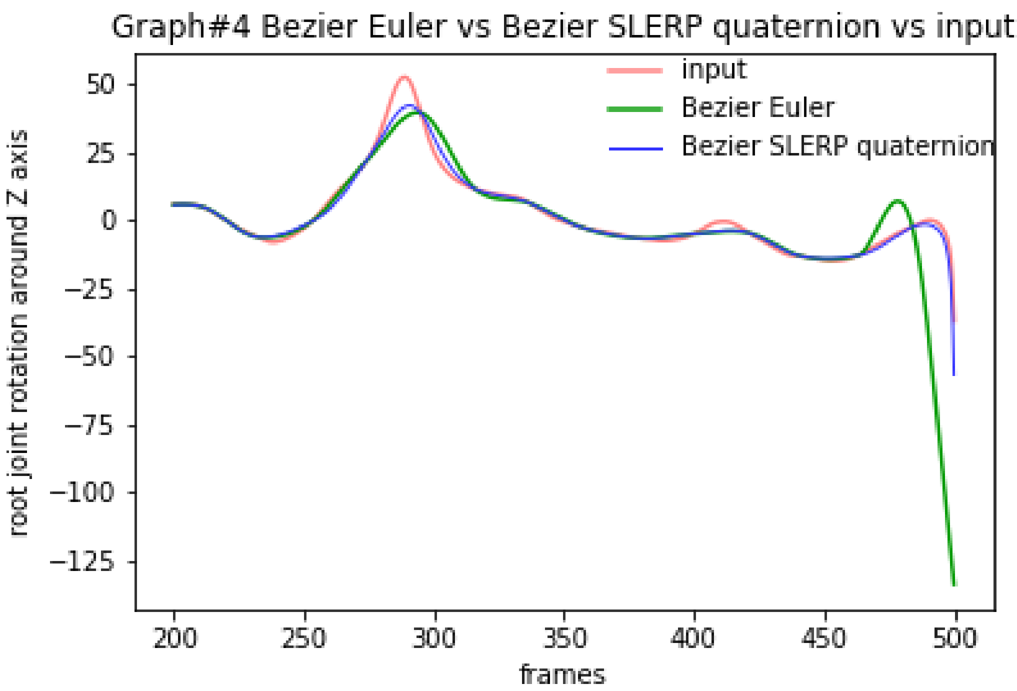
Graph#2 compares the results obtained when using quaternions to interpolate keyframes with different approaches. Spherical linear interpolation (shown in green) still produces nearly straight lines between keyframes, indicating that the resulting motion might be abrupt and unstable. In contrast, Bezier interpolation (shown in blue) produces smoother lines, suggesting that the motion is steadier.



Graph 3 and graph 4 show the results for root joint, rotation around Z axis, frame 200-500, for N=40, for 131_04-dance.amc input file.



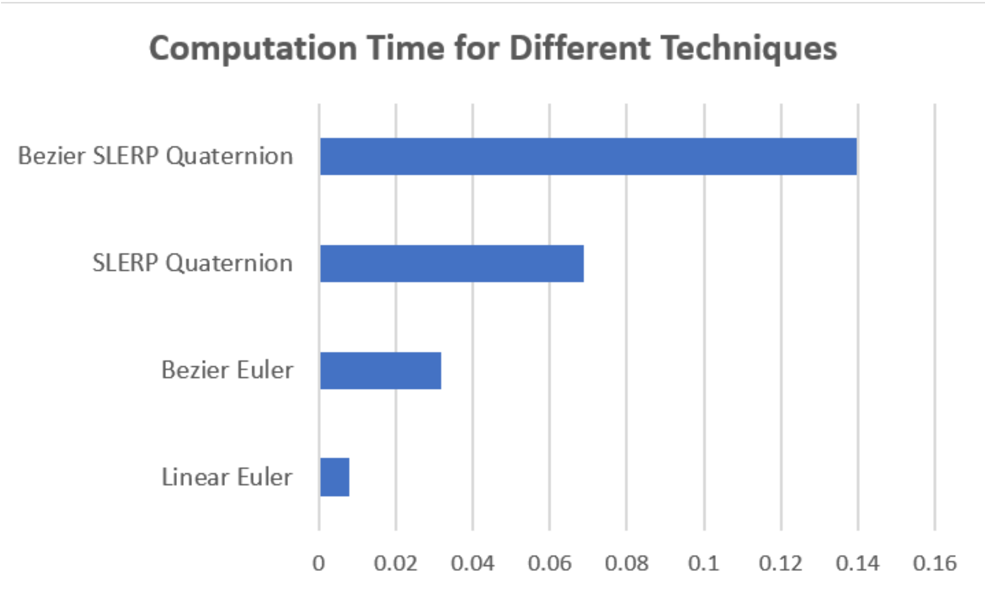
Graph#3 illustrates the results obtained when performing linear interpolation of keyframes using different angle representations: Euler angles (shown in green) and quaternions (shown in blue). Although the two interpolations are almost identical, the quaternion interpolation produces a smoother line, while the Euler angles interpolation still produces straighter lines.



Graph#4 displays the results obtained when using Bezier curves to interpolate motions with Euler angles (shown in green) and quaternions (shown in blue). Neither interpolation produces straight lines, but the motion obtained with Euler angles is still more abrupt compared to that obtained with quaternions, which is much smoother and closely follows the input (shown in red).

In summary, the results indicate that Bezier interpolation outperforms linear interpolation and that quaternions are superior to Euler angles for motion interpolation. Based on these findings, it can be concluded that Bezier Spherical Linear (SLERP) interpolation with quaternions is likely the optimal technique for interpolating human motion data among the four approaches.

However, when computation time is a crucial consideration, a different approach may be preferred.



Graph#5 computation time for different techniques for 131-04_dance.amc input when N = 30

It is important to note that Bezier Spherical Linear (SLERP) interpolation with quaternions is also the most computationally expensive. This is partly due to the demand for both Bezier curve implementation and the transformation between Euler angles and quaternions. Besides, linear interpolation is faster than Bezier interpolation because it does not require control points or the DeCasteljau algorithm to evaluate the curve. Therefore, if optimal performance is desired, it may be necessary to accept the higher computational time required by the chosen technique.

Interpolation Technique	Advantage	Disadvantage
Linear Euler	Lowest computation time	Unsteady, sharp motions
Bezier Euler	Smooth motions and relative lower computation time	Unsteady motions
SLERP Quaternion	Steady motions	Relative higher computation time
Bezier SLERP Quaternion	Steady and smooth motions	Highest computation time

Extra Credits:

- Analyze the computation time of the different interpolation techniques.
- Render different ground color and implement texture mapping.
- Render different skeleton color and modify head bone shape.