Pose Interpolation with Dual Quaternion Series

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Goal of the project

- Implement algorithm for smooth interpolation of pose (rotation and translation) using dual quaternions

Interpolation based on four measurements [1]

Background and Motivation

• Real-time tracking systems benefits from interpolation
  - animation
  - multi-modal sensor

• Quaternions
  - robust
  - fast
  - efficient

• Dual quaternion for rigid-body motions
Methods and materials

• Cumulative basis [3]:
  - Bezier curve
  - Quadric Bezier curves (QB) [1]
  - Hermite curves
  - B-spline curves

• Aitken [1]

\[ p(t) = \sum_{i=0}^{n} p_i B_i(t) \]


Experiments

• Aitken interpolation:
  - 51 poses, based on 3 measurements
  - 0.028 sec

• QB interpolation:
  - 51 poses, based on 3 measurements
  - 0.006 sec
Technical outline

• Programming languages
  - C++
  - Matlab

• Libraries
  - OpenIGTLink
  - Matio
  - Eigen
Sequence diagram

Matlab

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generateData

Server

--
quaternions + translations data

Client

--
quaternions + translations data as matrix

visualized

interpolated data
Project risks and problems

- Schedule problems
  - incorrect time management
  - lack of time

- Technical problems
  - integration with matlab
  - integration of all components
Results

• Design a prototype
  ✔ choose appropriate mathematical model for pose interpolation
  ✔ implement algorithm
  ✔ integrate with FRAMOS OTS
  ✔ test system
• Adaptation for medical application
  - discuss with partners medical applications and choose one
  - adapt system to specific application
  ✔ compare results before and after interpolation
• Documentation/Report
Experiments and measurements

- Data from Framos OTS (287 poses)
- Maximum tracker speed 20 Hz max (new poses every 50 ms)
- Delay from image acquisition to sending is 50 ms.
- Time measurements: - 0.1 ms between control points
Learning outcome

- Dual quaternions
- OpenIGTLink interface
- Client-Server architecture