HW3 - Inverse Kinematics

2022 Computer Animation and Special Effects

Outline

- Overview
- Objective
- Report
- Scoring
- Submission

Overview

- Use different bones to touch the ball
- Start bone
  - The last movable bone
- End bone
  - The bone that touches the ball

Objective

- Everything you need to implement is in kinematics.cpp (in src folder)
- There are three functions you need to implement in this homework
  - void forwardKinematics(...)
  - Eigen::VectorXf leastSquareSolver(...)
  - void inverseKinematics(...)
- Bonus
  - Take rotation limit of bones into consideration in void inverseKinematics

Objective (cont.)

- void forwardKinematics(...)
  - Goal
    - Implement forward kinematics, which is similiar to HW2

Objective (cont.)

- Eigen::VectorXf leastSquareSolver(...)
  - Goal
    - Find solution of linear least squares system, which will be needed for inverse kinematics
  - Hint
    - You might use some pseudo-inverse methods such as SVD
    - There are some built-in functions in Eigen that you can use
    - Eigen::Matrix3Xf means a matrix with 3 rows and unknown columns
      - Eigen::Matrix3Xf m(3, 10); // A matrix with 3 rows and 10 columns
    - Eigen::VectorXf means a vector with unknown size
      - Eigen::VectorXf v(10); // A vector with 10 elements

Objective (cont.)

- void inverseKinematics(...)
  - Goal
    - Implement inverse kinematics
    - We use inverse-Jacobain method in this homework
  - Hint
    - Review "kinematics.pptx" from p.20 - p.50
    - Review "acclaim_FK_IKnote.pdf" Inverse Kinematics part
    - Traverse from end bone to start bone
      - Make end bone touch the ball (target)
      - Start bone is the last movable bone, so you should stop at this bone
    - You can check struct Bone in bone.h (in include folder)

Report

- Suggested outline
  - Introduction/Motivation
  - Fundamentals
  - Implementation
  - Result and Discussion
    - How different step and epsilon affect the result
    - Touch the target or not
    - Least square solver
  - Bonus (Optional)
  - Conclusion

Scoring

- Forward kinematics - 0%
- Least square solver -20%
- Inverse kinematics - 60%
- Report - 20%
- Bonus - 5%

Submission

- Please upload only two files
  - kinematics.cpp
  - report_< your student ID >.pdf
  - Other necessary files
- Late policies
  - Penalty of 10 points on each day after deadline
  - Penalty of 5 points for incorrect submit format
- Cheating policies
  - 0 points for any cheating on assignments
- Deadline
  - Monday, 2022/05/16, 23:59

Recent Events

- 4/26   Proposal presentation order
- 5/2   Written proposal deadline < 5 pages
- 5/3   Contact TA if you have questions about HW1 scoring
- 5/3, 5/10   5 min oral presentation
- 5/8   Midterm course evaluation form due
- 5/16   HW3 due
- 5/17   Make sure your paper presentation topic & registration deadline
- 5/31(or 5/24) Paper presentation
- 6/14   Final project demo