Task 2: Motion Analysis of Robot Legs

(You may choose one)

SUBTASK 1

LEGS assembly 1 - continued

Perform an advanced motion analysis on the robot leg assembly, primarily using Altair Inspire Motion and Altair Activate. This involves setting up the CAD model appropriately, applying rigid body groups, defining joints, placing actuators, and conducting motion analysis. Additionally, you will use Altair Activate to run schematic simulations based on the Actuator Profile provided.

Detailed Steps:

1. **Importing the CAD Model**:
    - Import the leg assembly from your Task 1 into Altair Inspire.
    - Ensure that the assembly is aligned with the appropriate reference planes (XYZ).
    - Attach the push rods: Two from the tibia motors to the foot heel and another (Push rod cylindrical piston) from the thigh to the center of the knee-L-bracket.
2. **Defining Rigid Body Groups**:
    - Create rigid body groups for parts that move together as a single unit.
    - Specify which parts are grounded to form the foundation of your model.
3. **Defining Joints and Pins**:
    - Establish the right constraints and joints between the leg components.
4. **Placing Actuators/Motors**:
    - To simulate the movement from motors. Place actuators or motors on the servo adapter slots in the CAD model.
5. **Physics Configuration for Actuators**:
    - Using the provided 'Actuator Profile.pdf', assign the relevant physical properties and configurations to each actuator.
6. **Motion Analysis in Altair Inspire**:
    - Run multi-body dynamics simulations to evaluate the motion characteristics of the leg assembly.

7. **Triggering Motion in Altair Activate**:
    - Use Altair Activate to set up schematic simulations.
    - Apply the essential boundary conditions and values for each servo, as dictated by the analysis.
8. **Schematic Diagram**:
    - Create a comprehensive schematic diagram that includes essential boundary values for the movements of each servo, as per the motion analysis.

Deliverables:

- A screen timelapse of your session while setting up motion analysis.
- Motion simulations videos.
- The refined CAD model with all the applied configurations.
- A comprehensive report detailing each step and your findings.
- The schematic diagram developed in Altair Activate, along with any accompanying documentation.

Resources:

https://youtube.com/playlist?list=PLQ7KUGFuVz4tfImNdUIOj_Lekk0a9mK3v&si=YnQRu7vVmYnsQ25F

https://youtu.be/Wa75AP1nak8?list=PLQ7KUGFuVz4tfImNdUIOj_Lekk0a9mK3v

https://youtu.be/e7p9ilxSBik

https://youtu.be/iFIKaUE8JZs?list=PLQ7KUGFuVz4tfImNdUIOj_Lekk0a9mK3v

SUBTASK 2

Build a complete and functioning model of a humanoid robot, extending from the previous work done on the leg assembly. This entails assembling the torso, arms, and head, along with all actuators, servos, and other mechanical parts using the attached reference model for study and observation. And mainly ensuring that they are fully operational in terms of their constraints and degrees of freedom. Feel free to be creative and suggest any different approach with full design liberation.

Detailed Steps:

1. **Initial Steps**:
    - Continue from the leg assembly completed in Task 1.
    - Import the Attached STL files of the complete humanoid body (both the version without arms and the separate arms) to Altair Inspire for study and observation.
2. **Attach New Components**:
    - Add the new components as per the attached files, which include but may not be limited to the torso, arms, head, and any additional servos.
3. **Assembly Alignment**:
    - Align all parts correctly in their corresponding positions.
4. **Creating Joints and Constraints**:
    - Place joints at necessary connection points, for connective components at hips, shoulders, elbows, etc.
    - Apply appropriate constraints and rigs to ensure realistic motion.
5. **Attach Arms**:
    - Specifically, attach the arms to the shoulder servos and apply the appropriate constraints and joints for arm movement.
6. **Physics Configuration**:
    - Extend the previous actuator profiles to the newly added components, ensuring that they are physically accurate.
7. **Full Model Validation**:
    - Perform a comprehensive structural analysis on the complete humanoid model to validate all joints, constraints, and movements.
8. **Documentation**:

- Maintain a log of the assembly process, noting any challenges faced and how they were overcome.

Deliverables:

- A complete humanoid robot assembly, built in Altair Inspire, with all joints, constraints, and actuators fully functional.
- A screen timelapse and documentation of the assembly process, the constraints applied, and the motion validation results.

Resources:

https://youtube.com/playlist?list=PLQ7KUGFuVz4tfImNdUIOj_Lekk0a9mK3v&si=YnQRu7vVmYnsQ25F