Introduction to Mechanical Engineering, HW CAE DYN 1

Inverse Dynamics Problem

Rifle simulation

INNOPOLIS UNIVERSITY

Task 1

Short Task Description

Description: Solve Inverse Dynamics problem for four link bar mechanism by NX Motion Analysis application.

Artifacts:

- Zip archive with NX detail files (.prt) and simulation (.sim)
- A picture with mechanism angle limits, represented as a pie chart.

Task 1

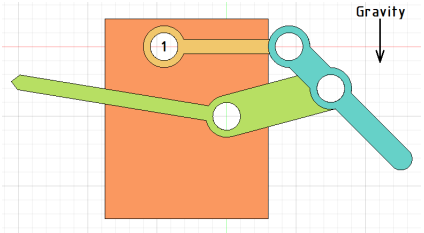
Extended Task Description

Zip archive, which contains all needed data:

HWs/HW_CAE_DYN1/task_data

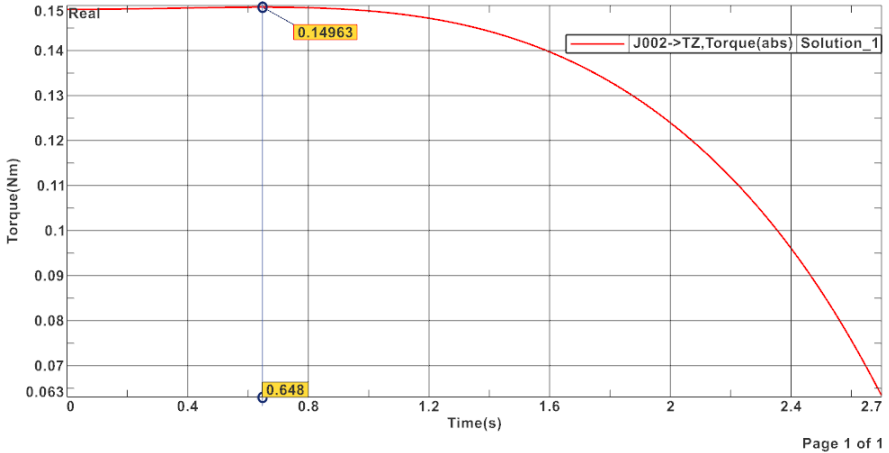
1st joint is controllable, others — not.

1. **Find angle limits** (where the mechanism stuck) for controllable joint, using NX (either Modeling, or Animation Designer).
2. **Make the scene in Motion Analysis**. All links are made from «Bronze». You need to add joints, contacts, direct earth gravity correctly.
3. Choose the biggest angle gap between joint limits and put your link in the beginning of it.
4. Apply constant angular acceleration for 1st joint — 0.2 rad/s^2
5. **Find a torque for 1st joint** for such angle gap, using NX (any solver):



Task 1

Torque plot, which should be received



Task 2

Short Task Description

Description: Create a simplified geometric model of the bullet in the barrel of the rifle at the moment of firing by NX Motion Analysis application.

Artifacts:

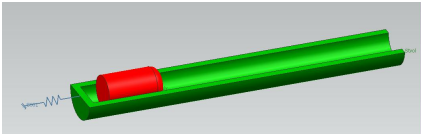
- Zip archive with NX detail files (.prt) and simulation (.sim)

Task 2

Extended Task Description

Create a simplified geometric model of the bullet in the barrel of the rifle at the moment of firing. Approximate parameters of the model:

- Bullet weight: 9 g.
- Barrel weight: 250 g.
- Gunpowder combustion force: 500 N.
- Powder combustion time: 0.01 s.

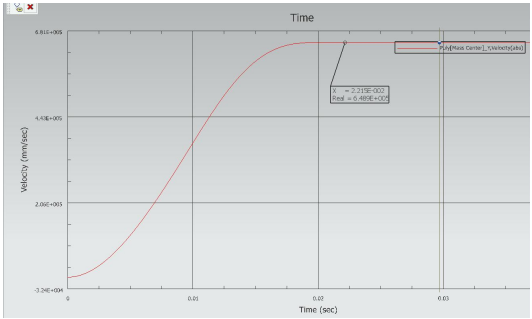


You need to:

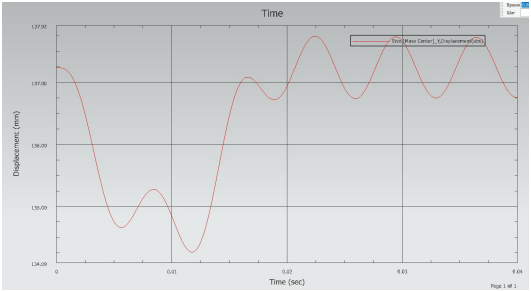
- Give graphs of the velocity of the bullet and the barrel (plot (a)).
- Determine the velocity of the bullet at the moment of departure from the barrel.
- Calculate (experimentally) the spring stiffness , which should bring the striker to its initial state in about 0.02 seconds after the shot. Give a graph of the movement of the striker at the moment of firing (plot (b)). Determine the ”recoil distance” of the striker.

Task 2

Referenced plots



(a) Graphs of the velocity of the bullet and the barrel



(b) Graph of the movement of the striker at the moment of firing

Deserve “A” grade!

– Oleg Bulichev

o.bulichev@innopolis.ru

@Lupasic

Room 105 (Underground robotics lab)