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Example: Façade 2D Bot

Abstract

This report investigates a robotic arm of six degrees of freedom that mobilize objects. The mechanism consists of 7 parts and 4 joints and rotates around the Y-Axis. Variation of tension on the tips of the arm controls the x-y-z motion of the end-effector. The ADAMS application simulates the 4 motors and the gripper forces. Results provide power requirements and dynamic forces needed for the detailed design of the mechanism.

1. Introduction

Fig. 1 shows a diagram of the Façade 2D Bot.

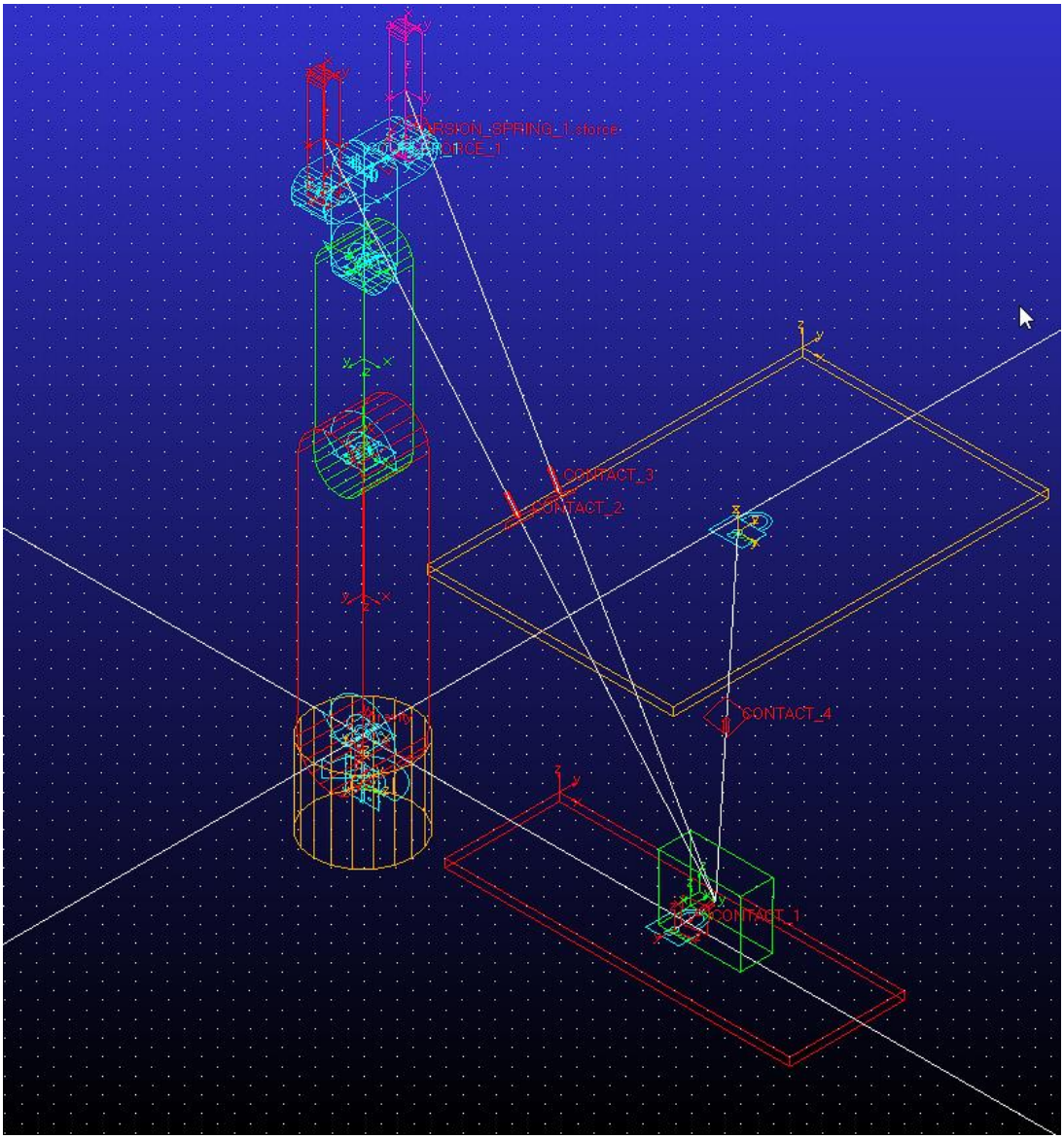
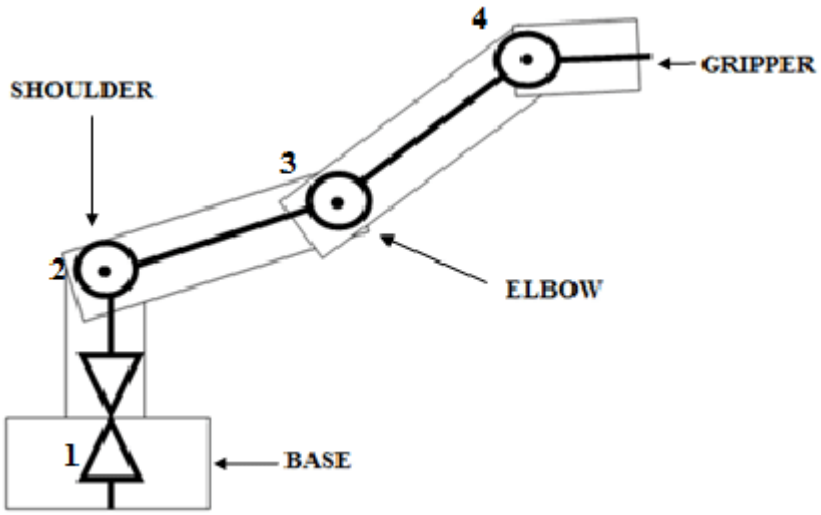
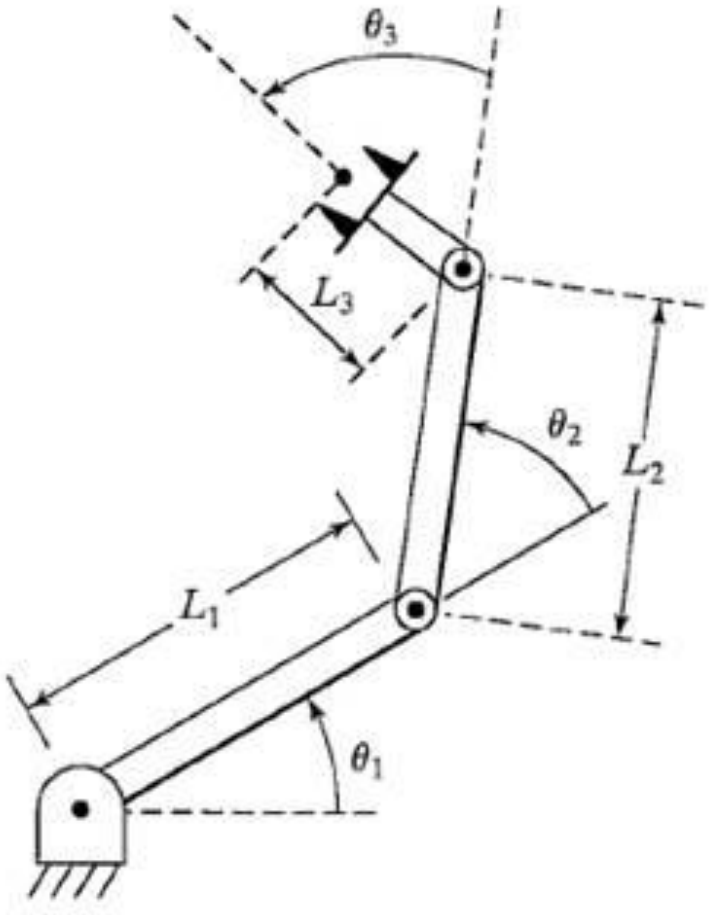


Fig. 1 A schematic diagram of the Façade 2D Bot



Figs. 2, and 3 show free body diagram and a Kinetostatic diagram.



Figs. 2, schematic of free body diagrams of the Façade 2D Bot mechanism

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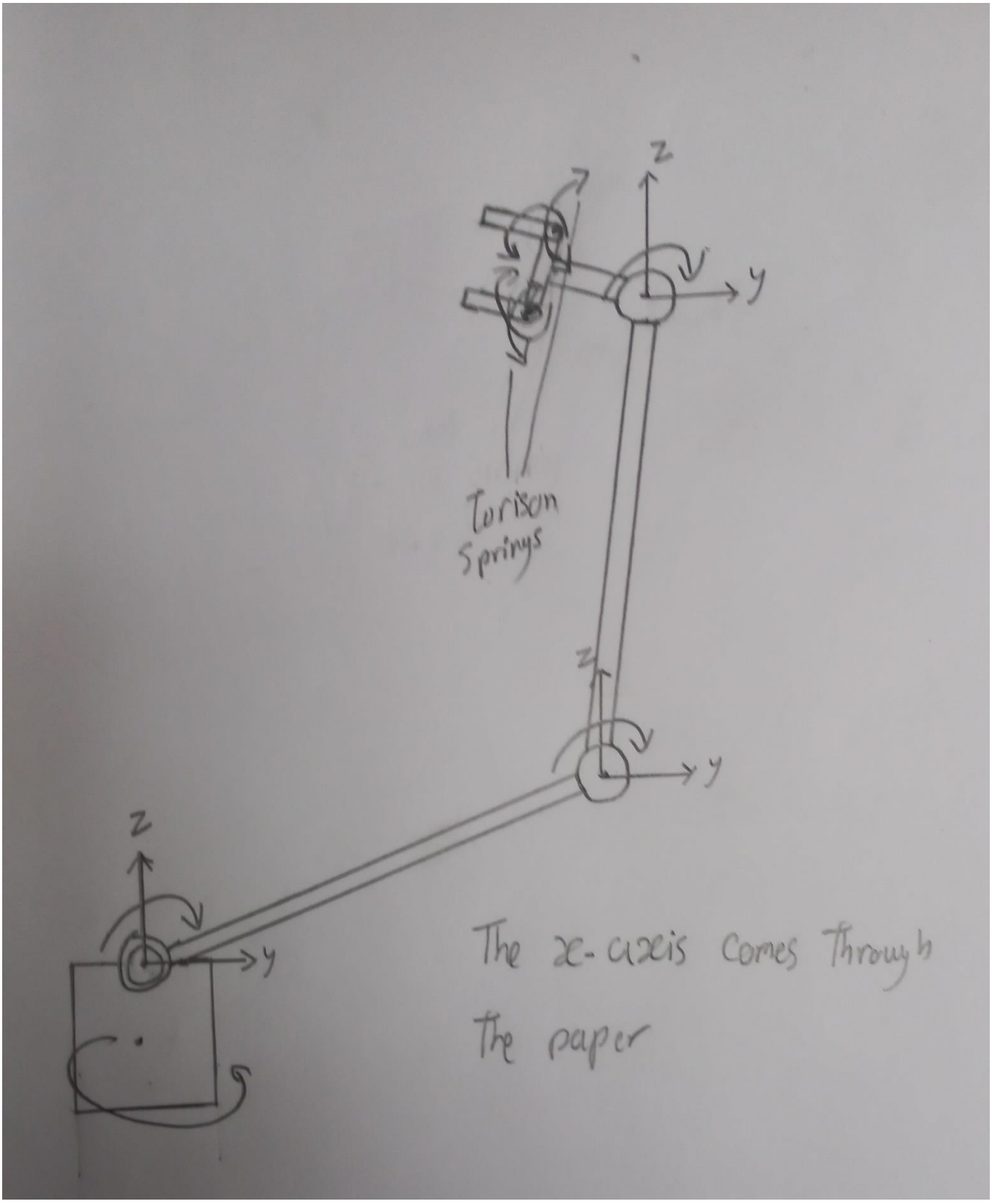
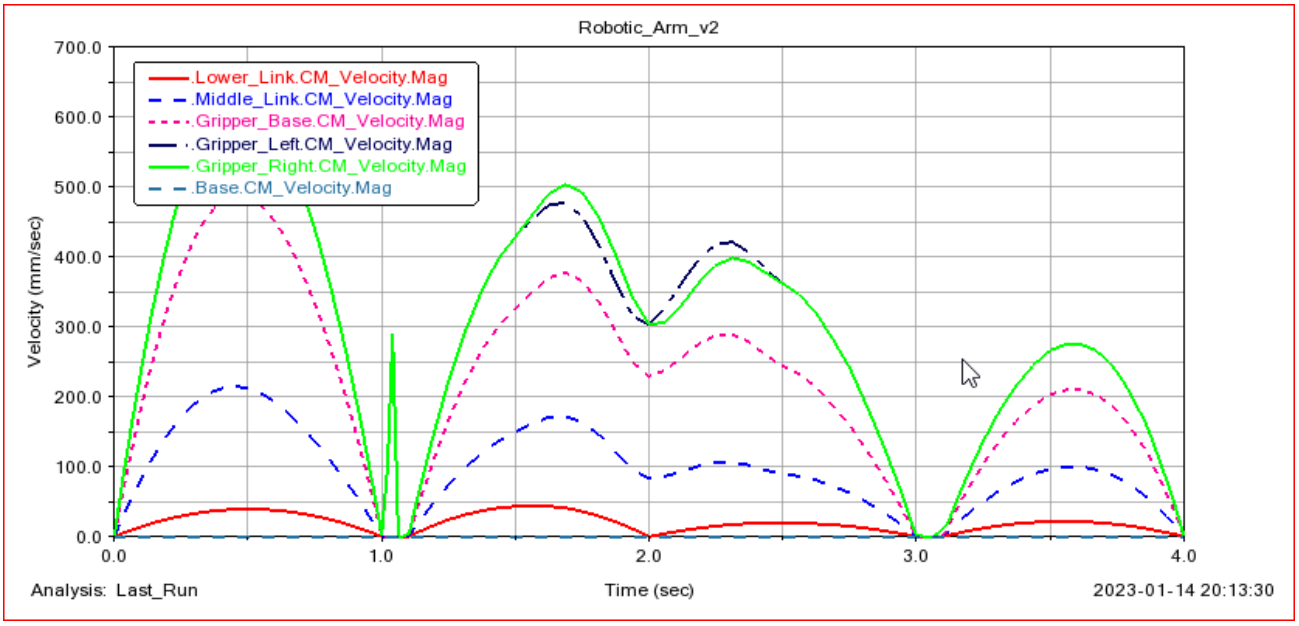
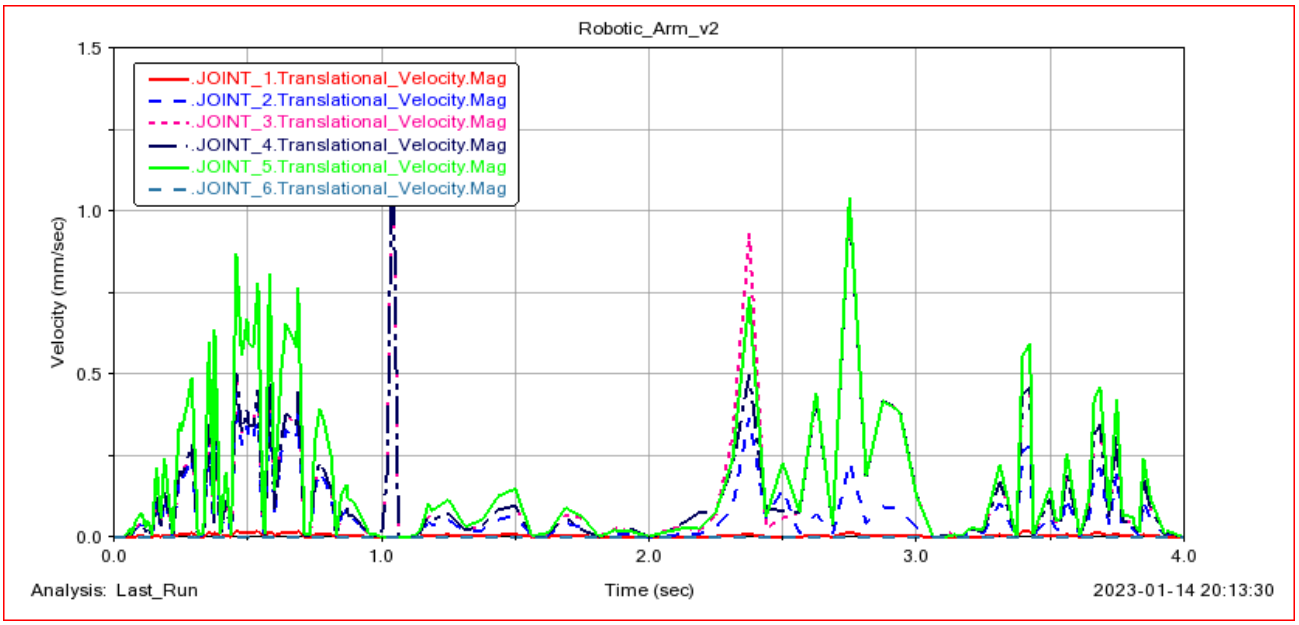


Figs. 3, schematic of the kinetostatic body diagrams of the Façade 2D Bot

Figs. 4 shows a schematic diagram of input/output motion and power types.





Figs. 4, a schematic diagram of input/output motion and power types

Below are the Four dynamical equations of motion of driving linkage used in ADAMS.

- Base Motion: STEP (time, 1.5, 0, 2.5, 90d)
- Lower Link Motion: STEP (time, 0, 0, 1, -20d) + STEP (time, 1.1, 0, 2, 20d) + STEP (time, 2, 0, 3, -10d) + STEP (time, 3.1, 0, 4, 10d)
- Middle Link Motion: STEP (time, 0, 0, 1, -95d) + STEP (time, 1.1, 0, 2, 50d) + STEP (time, 2, 0, 3, -40d) + STEP (time, 3.1, 0, 4, 40d)
- Top Link Motion: STEP (time, 0, 0, 1, 20d) + STEP (time, 1.1, 0, 2, -20d) + STEP (time, 2, 0, 3, 65d) + STEP (time, 3.1, 0, 4, -20d)

2. ADAMS Model

Figs. 6, and 7 show a schematic diagram of the mechanism and its ADAMS model. Fig. 7a shows a planar view of the simulated mechanism, and Fig. 7b shows an isometric view.

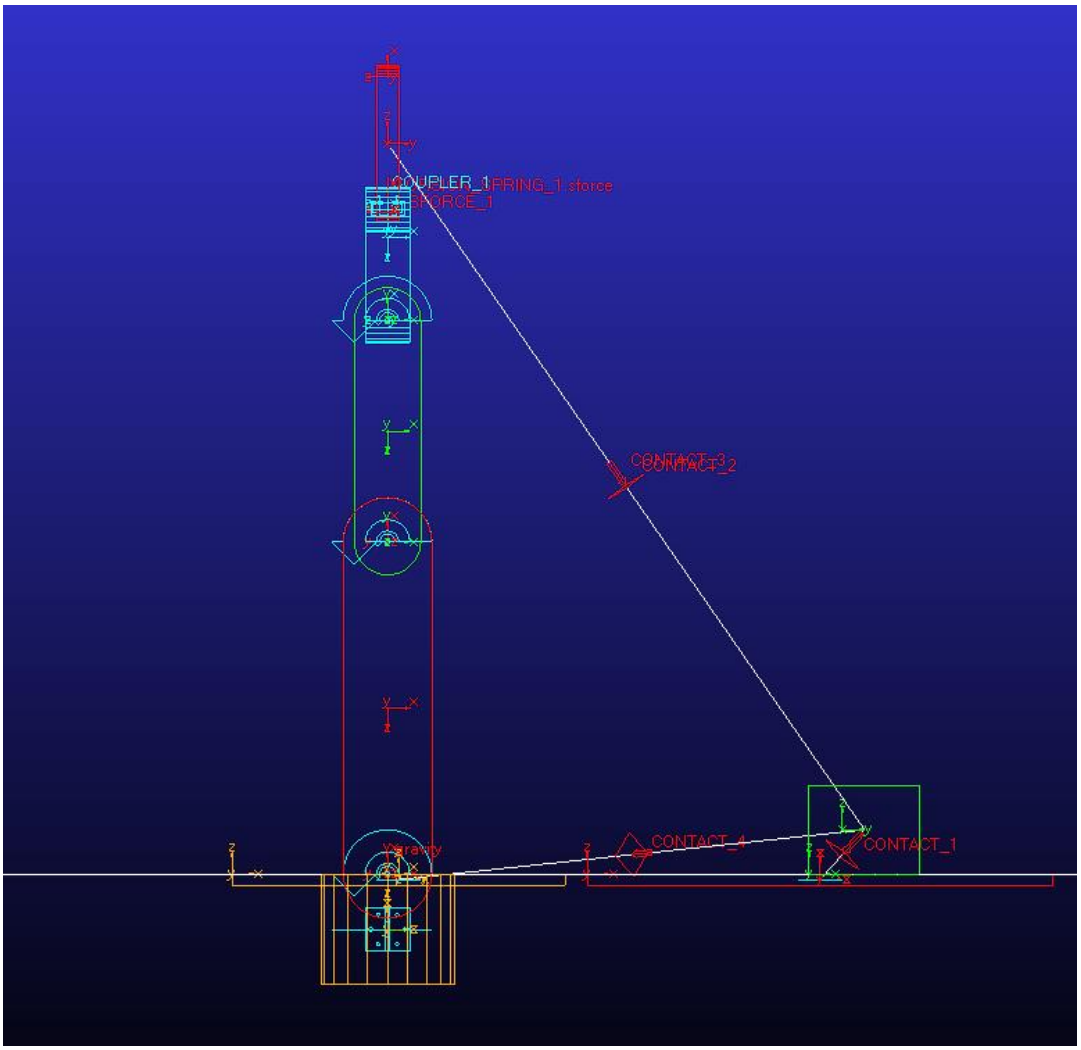


Fig. 6, a schematic diagram of the mechanism

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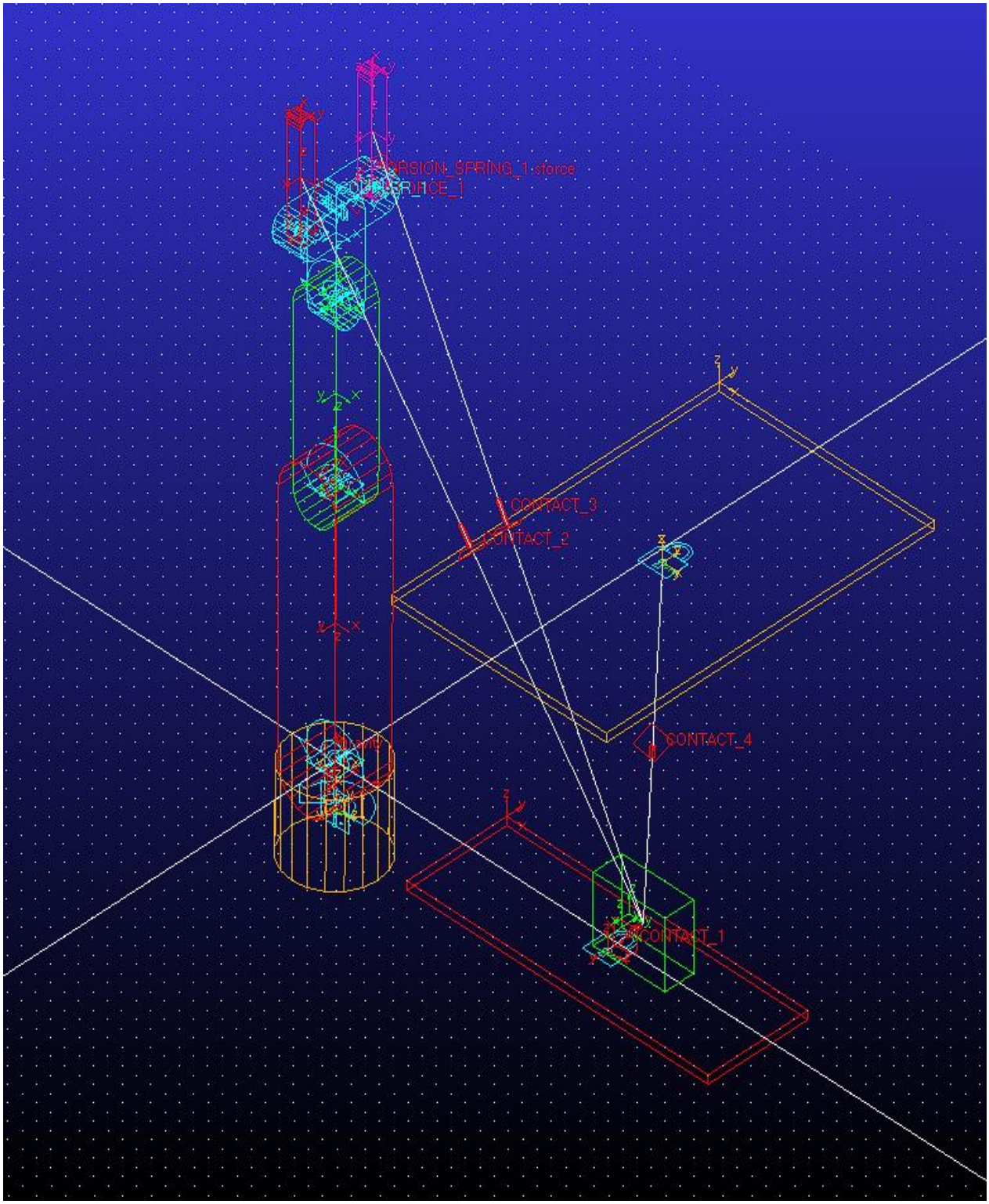

Fig. 7a, the ADAMS model of the mechanism

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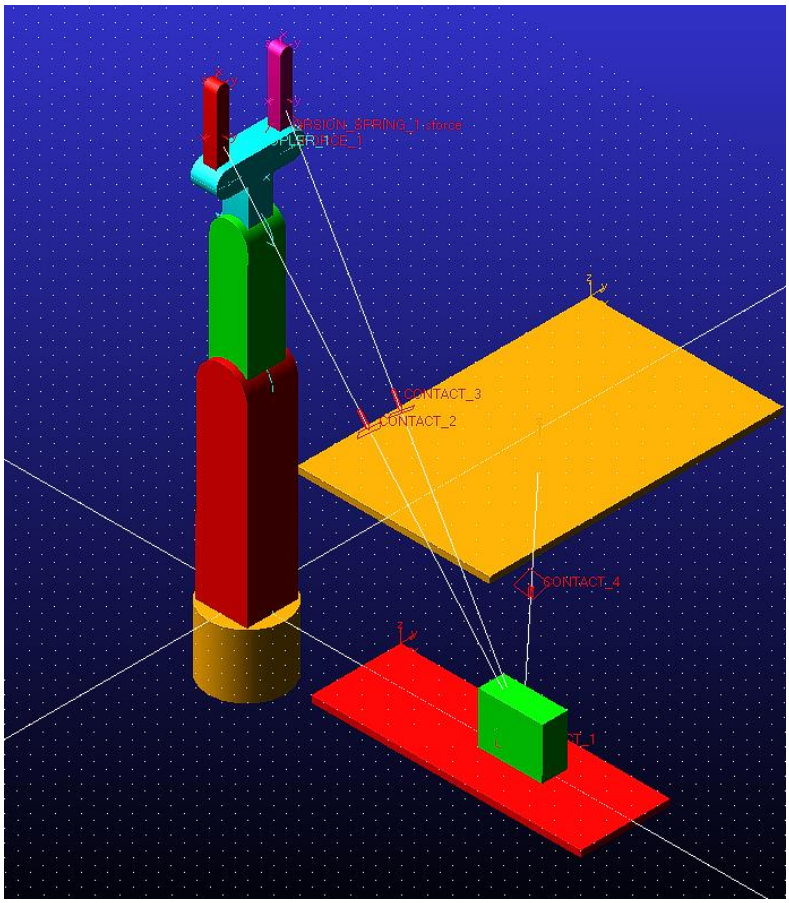


Fig. 7b, the ADAMS model of the mechanism

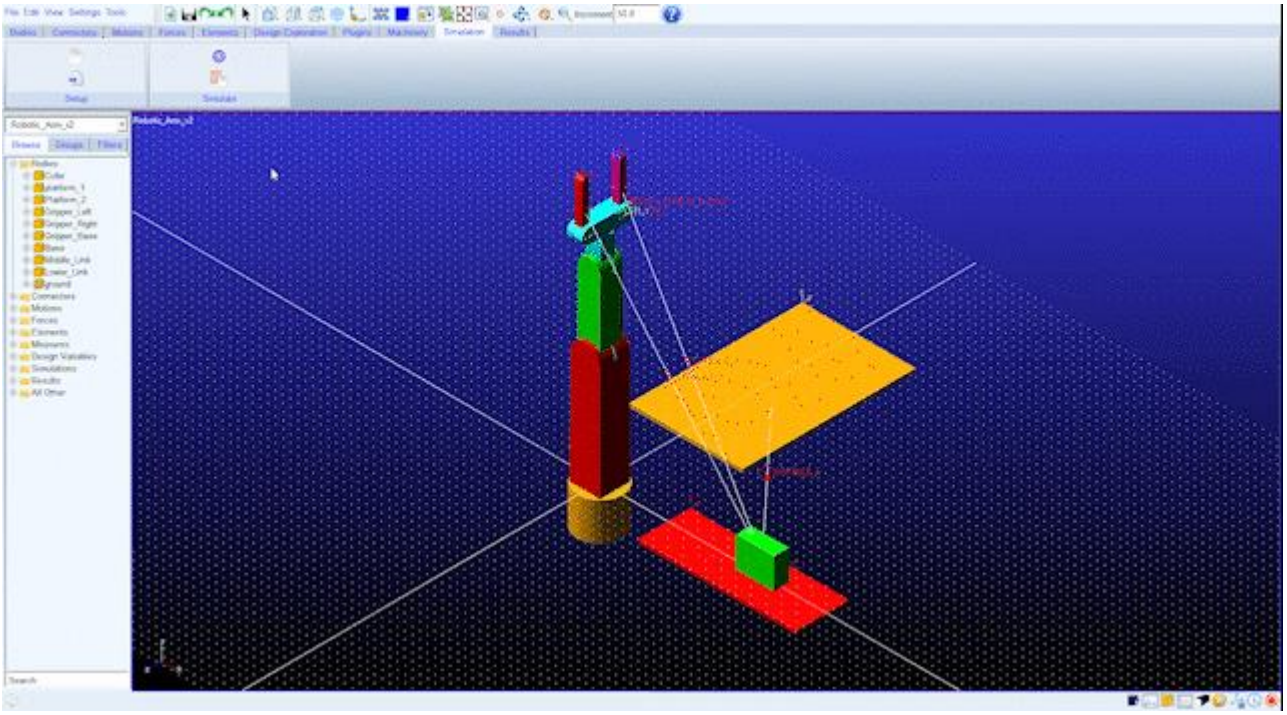
3. Mechanism Dynamical Parameters & ADAMS Simulation

Table 1 lists the dynamical parameters of the moving bodies of the mechanism.

Table 1 dynamical parameters of the moving bodies of the mechanism

Part	Mass	Inertia (ixx)	Inertia (iyy)	Inertia (izz)
Base	1.1028403931	496.2781768857	477.8975036678	477.8975036678
Lower Link	2.2579426517	6506.0735865636	6492.5875776594	588.6320304808
Middle Link	0.8648083062	1168.4712633086	1165.2709700954	126.5209526304
Gripper Base	0.4084656629	224.5346813533	157.7942426762	93.9714828442
Gripper Right	5.2832603933E-02	20.7040766006	20.6909066704	0.8673734669
Gripper Left	5.2832603933E-02	20.7040766006	20.6909066704	0.8673734669

MSC ADAMS solves the 6DOF of each link using the dynamical properties of the links listed in Table 1, and animate the mechanism. Video1 shows ADAMS animation of the mechanism.



Video 1 ADAMS animation of the simulation

4. ADAMS Simulation (Driver Power & Torque)

Figs 8 shows torque and power of the driving motor.

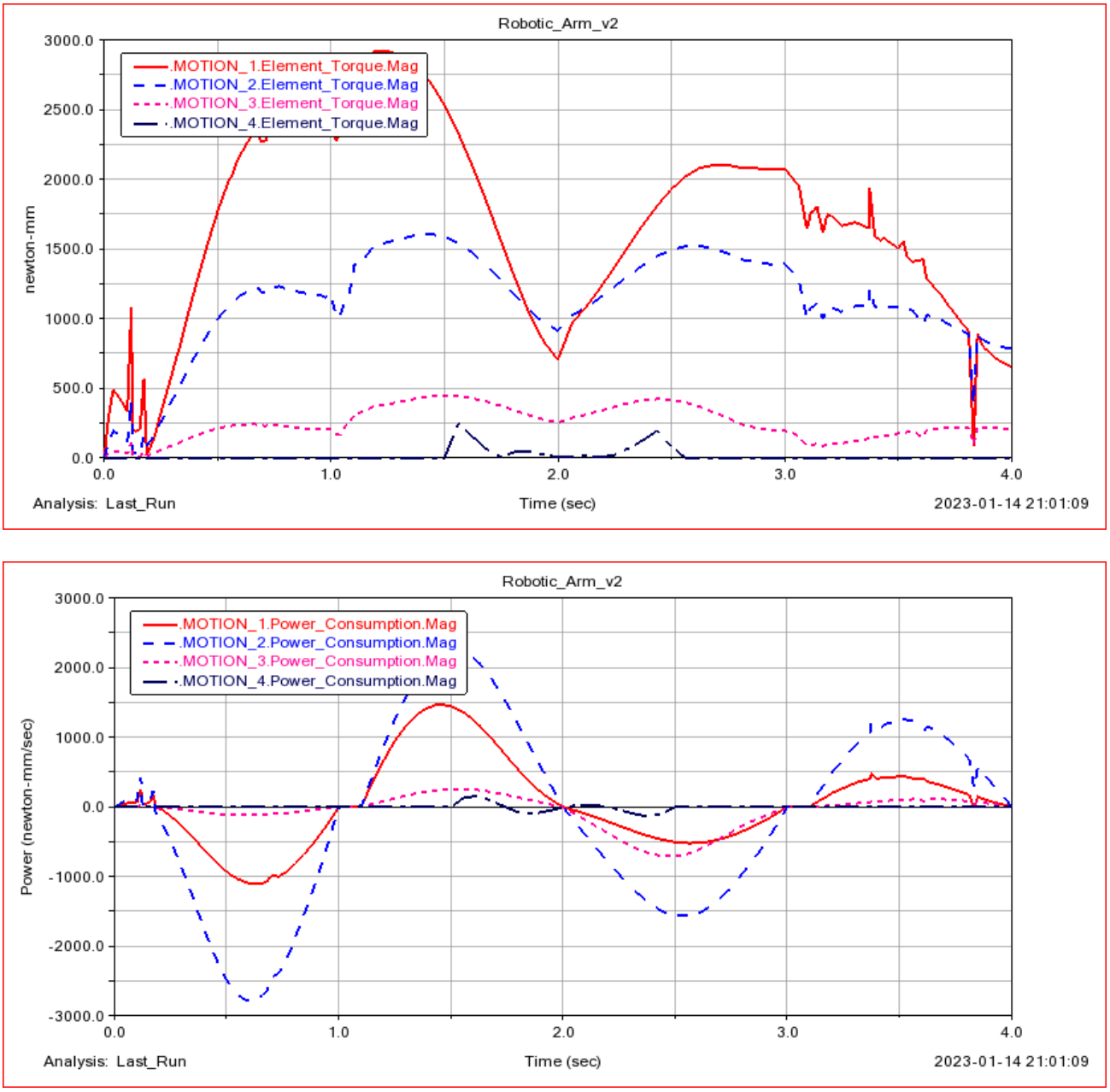


Fig. 8 driving motor torque & power

From Fig. 8 shows the maximum power and torque for selecting a proper motor are:

1. Maximum Torque: 250.3412,
2. Maximum Power: 154.2921

Searching the net shows possible model selection and their costs.

1. OWI Inc Robotic Arm Edge, $44
2. Yahboom Adults Robot Arm, $1468
3. wlkata Mirobot 6DoF Mini Industrial Robotic Arm Professional Kit, $2050

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4. ADAMS Simulation Results (Linkages Forces & Torques)

MSC ADAMS solves the 6DOF of each link and animate the mechanism for the forces and torques applied on the various linkages of the mechanism. Fig. 9-?? Show forces and torque applied on linkages 2-.

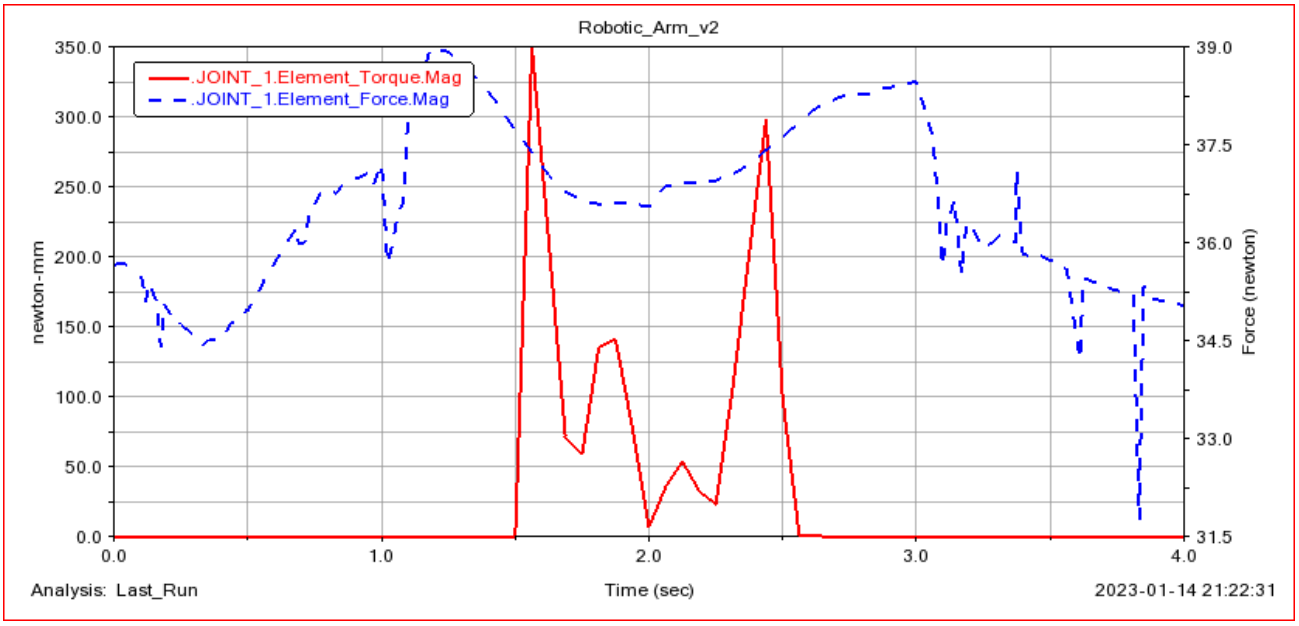

Fig. 9 forces and torques on linkage No 1

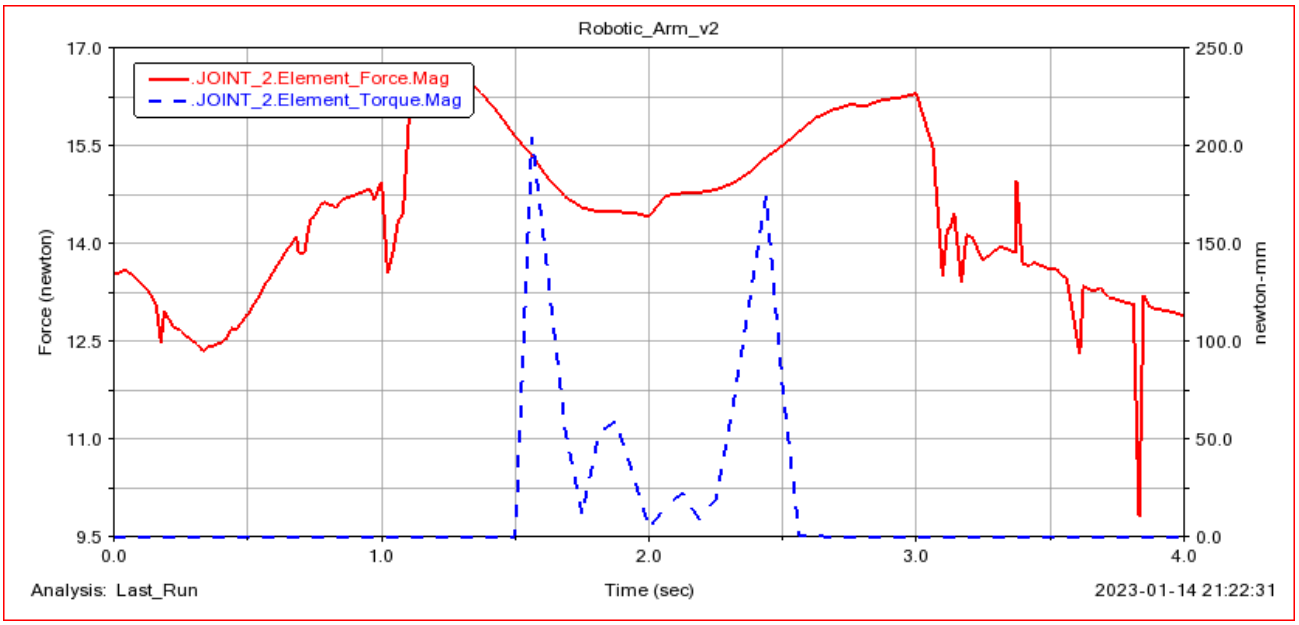

Fig. 10 forces and torques on linkage No 2

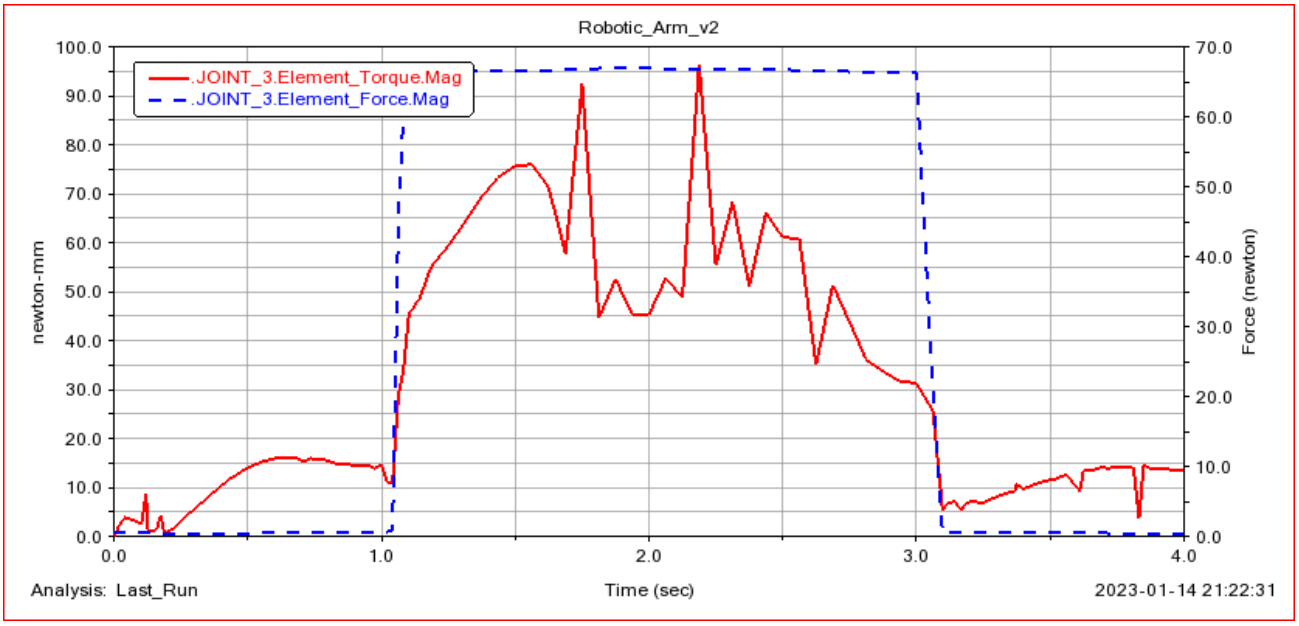

Fig. 11 forces and torques on linkage No 3

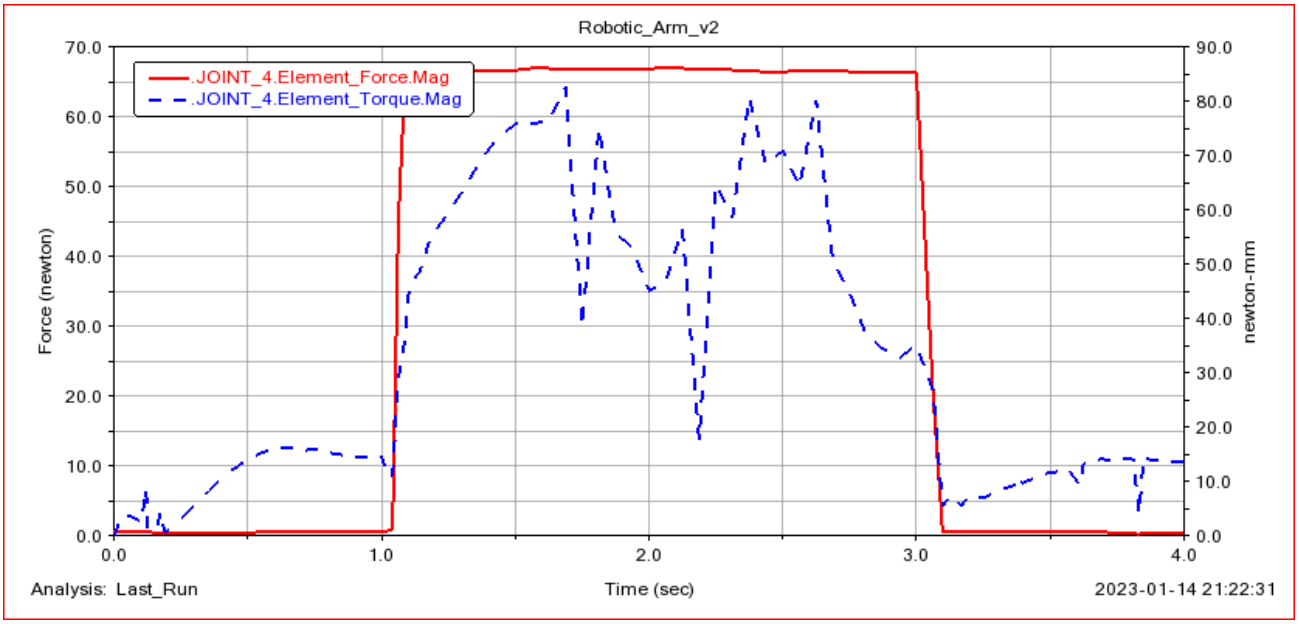

Fig. 12 forces and torques on linkage No 4

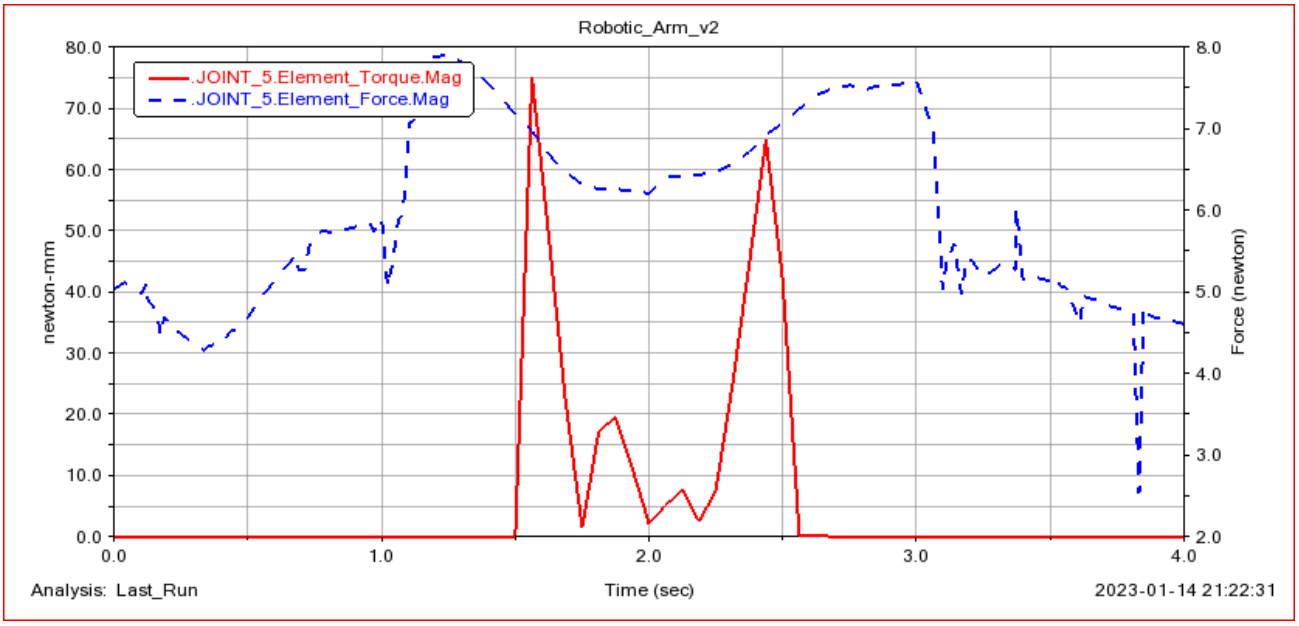

Fig. 13 forces and torques on linkage No 5

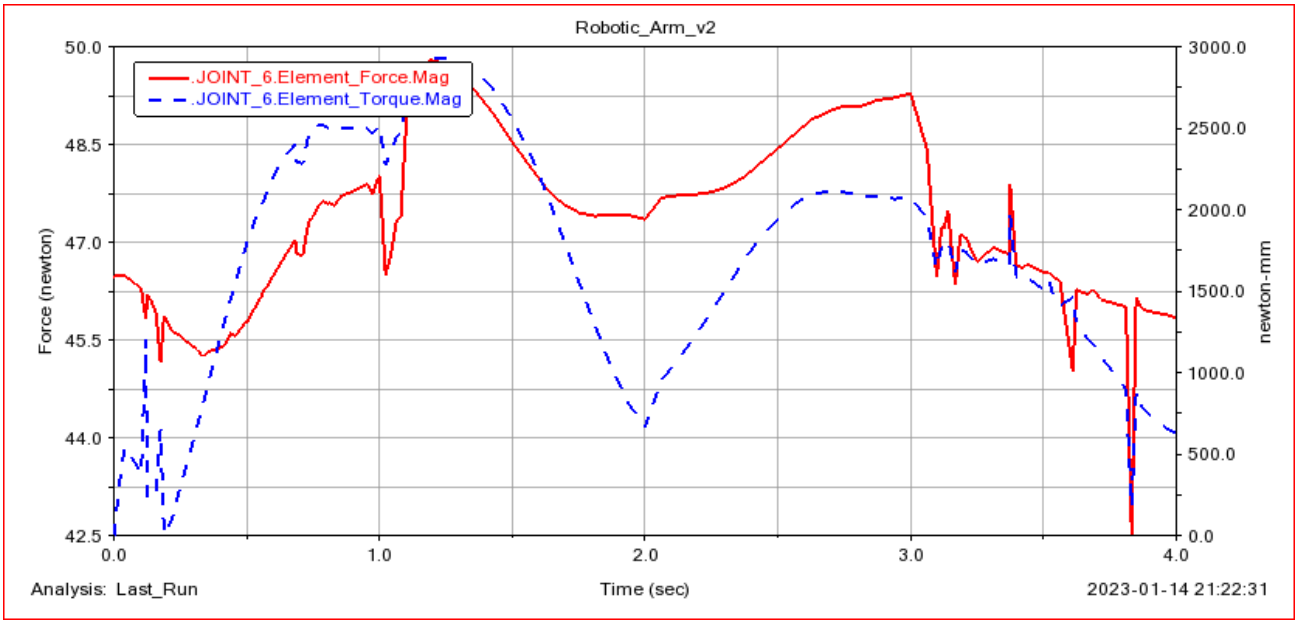

Fig. 13 forces and torques on linkage No 6

5. Conclusions and Future Work

With the results at hand it is reasonable to assume that a real application with this bot could be developed, where it can be used it in factories, stores, malls and any situation where a repetitive moving task is required.