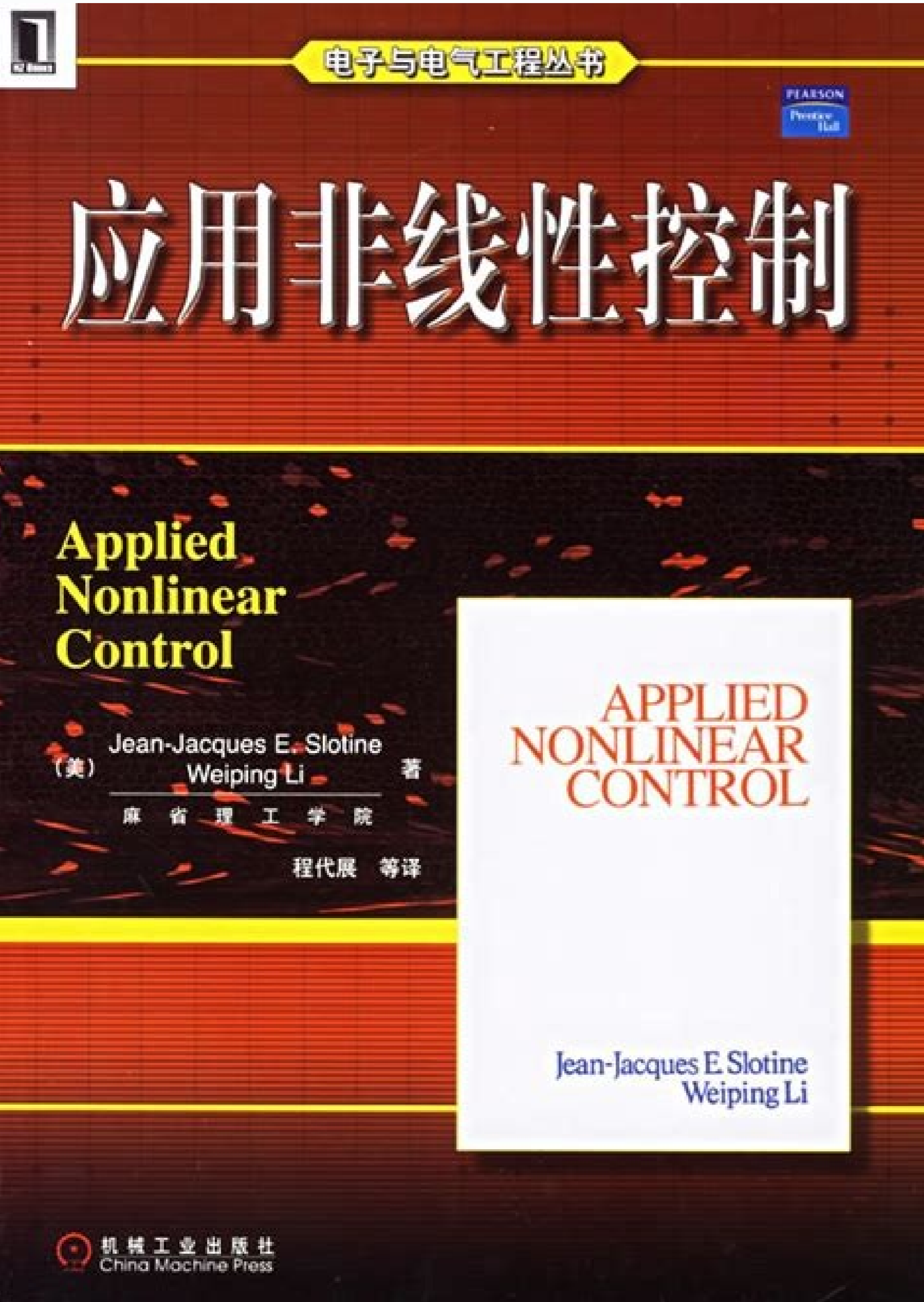
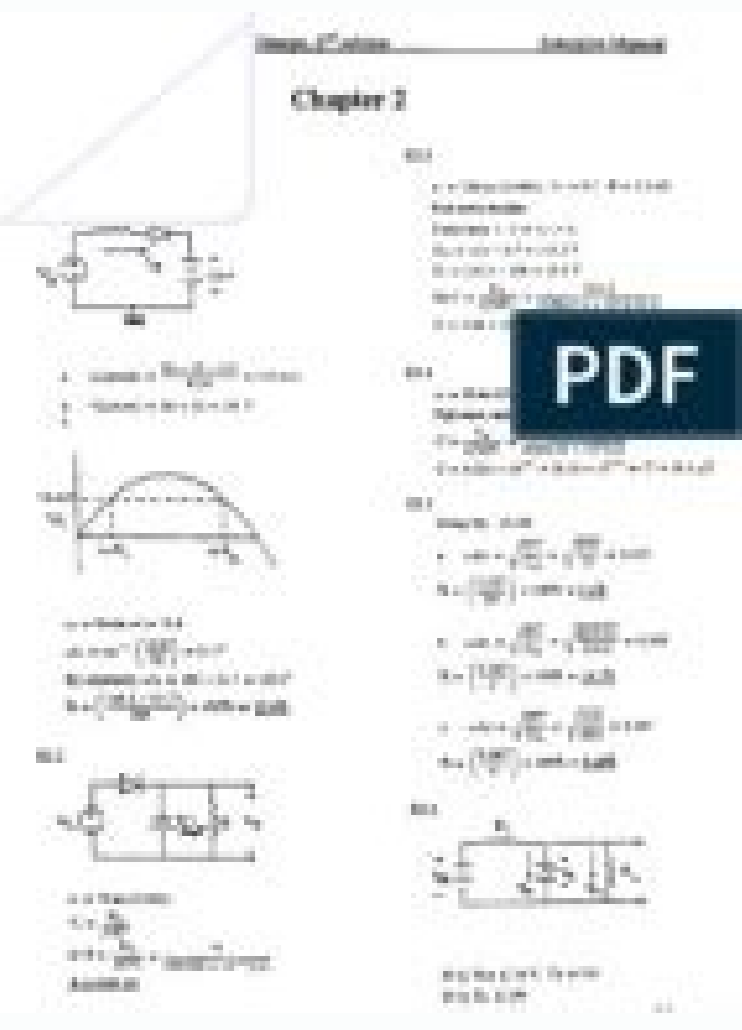




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6. Simulation

In this section, simulation results of applying model predictive control on a 3D cable robot will be presented. **Table 1.** shows the dimensions of the cable robot. We consider a definite movement of the platform from $X_0 = [-0.1, -0.1, 1.5, 0.002, 0.001, -0.001]^T$ to $X = [0.2\sin(t), 0.4\sin(t), 1 + 0.2t^2 - 0.03t^3, 0, 0, 0]^T$, on a desired trajectory shown in dotted lines by **Figures 4(a) to 4(f)**, for position/orientation of the platform.

Also, we consider the parameters of the model predictive controller as: the control horizon $N = 25$, S , Q , and R

of Equation (10), $R = I$, $Q = I$, $S = 0.01I$, and Q_c of Equation (15), $Q_c = I$.

Since the controller needs platform's position/orientation, at first, we must solve forward kinematics of the robot. This has been carried out by the authors using neural network algorithm [24].

Figure 4 shows the model predictive controller with input-output linearizing worked quite well and a trajectory tracking are done. **Figure 5** shows the six tensions in the cables vs. time. As it can be seen, all of them remain positive during the motion.

Table 1. Dimensions of the cable robot.

Position vector	X(m)	Y(m)	Z(m)	Position vector	x(m)	y(m)	z(m)
a_1	1.1547	-2	3	b_1	-0.2887	-0.5	0
a_2	1.1547	-2	3	b_2	0.5774	0	0
a_3	1.1547	2	3	b_3	0.5774	0	0
a_4	1.1547	2	3	b_4	-0.2887	0.5	0
a_5	-2.309	0	3	b_5	-0.2887	0.5	0
a_6	-2.309	0	3	b_6	-0.2887	-0.5	0

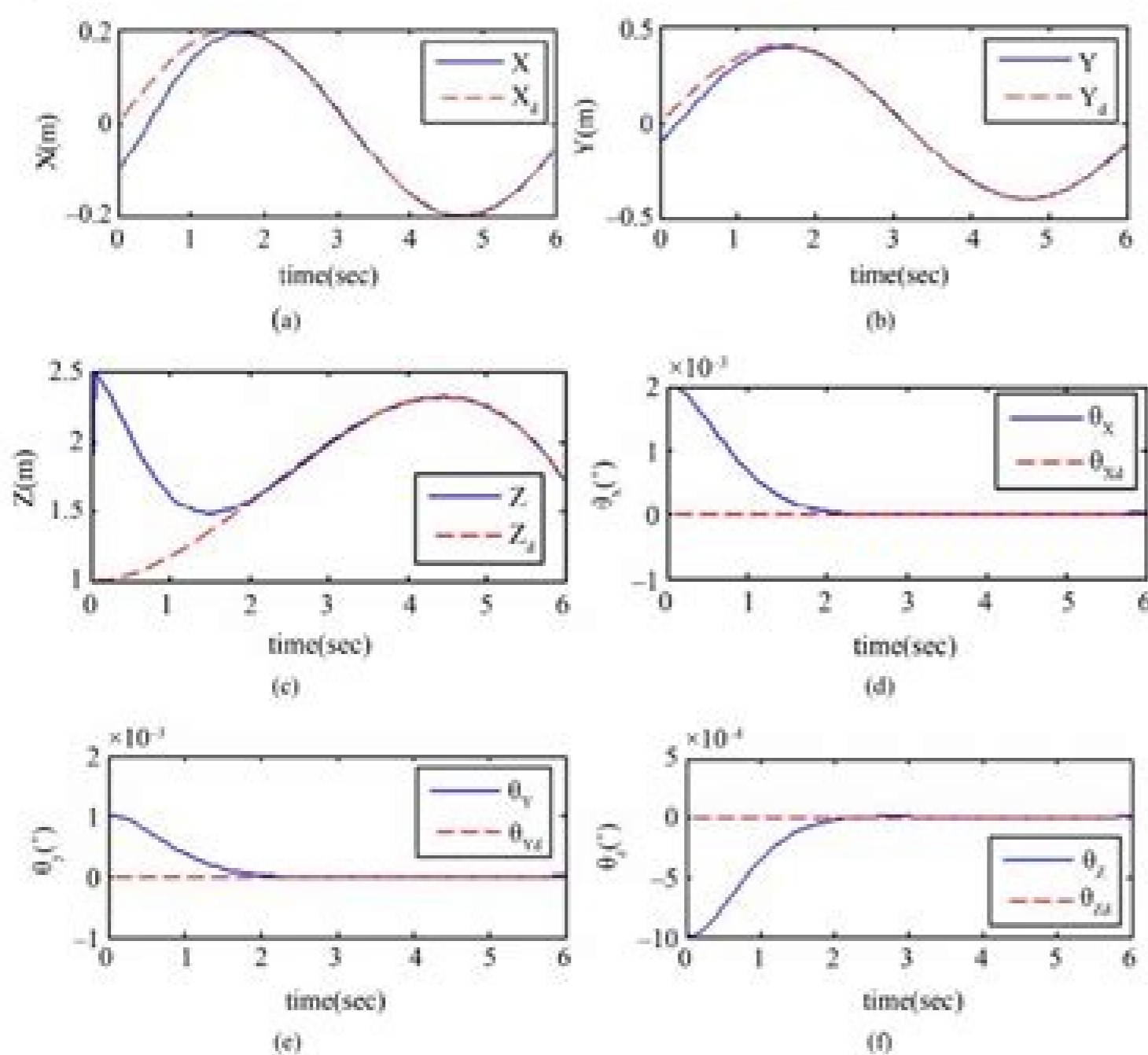


Figure 4. Plots of desired and actual position and orientation of the platform. (a)-(c) position in X-Y-Z directions, respectively, (d)-(f) orientation around X-Y-Z direction, respectively.

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