

MECH 573 Mechanics of Robotic Systems

Notes: Exercise numbers in all assignments correspond to the *Exercises* at the end of the text. Assignments are due on the date indicated, at the beginning of the lecture. Since solutions are handed out during the lecture time, **late submissions will not be accepted.**

Assignment 1

Assigned: January 6th, 2005

Due: January 20th, 2005

- 1.1 (15%) Exercise 4.10.
- 1.2 (15%) Exercise 4.15.
- 1.3 (15%) Exercise 4.21.
- 1.4 (20%) Exercise 4.23.
- 1.5 (20%) Exercise 4.24.
- 1.1 (15%) Exercise 4.25.

Assignment 2

Assigned: January 20th, 2005

Due: February 3rd, 2005

- 2.1 (25%) The data sheet of the Adept Cobra 600 robot is attached. Determine the minimum time it will take the robot to complete one full cycle of repeatability tests that consist in sweeping joint angles throughout their whole joint-mobility range using:
 - (a) a 3-4-5 polynomial;
 - (b) a 4-5-6-7 polynomial; and
 - (c) a cycloidal motion.
- 2.2 (25%) Exercise 5.1.
- 2.3 (25%) Exercise 5.3
- 2.4 (25%) Exercise 5.4

Adept Cobra 600



The Adept Cobra 600 is a "best-in-class", four-axis, table-top mounted SCARA robot. Designed and developed in response to customer demand for increased reach, and combined with Adept's easy-to-use software, this robot is an attractive solution for both fixed-automation and manual production methods.

With an overall reach of 600 mm, and an increased Z-axis stroke to 210 mm, the Adept Cobra 600 has a maximum payload

capability of 5.5 kg. The robot's design is unsurpassed for high speed, reliable, light-payload assembly, handling, and packaging applications. The Adept Cobra 600 incorporates the same base mounting pattern as Adept's previous 550 series robots, as well as the same tool-flange for customer's tooling interchange-ability. The hollow Z-axis quill provides a convenient passage for both pneumatic, and electrical user lines and has been strengthened for greater rigidity in case of collisions with peripheral equipment.

Adept software and controllers further simplify integration of the robot by combining all of the functions found in a typical robot workcell including motion control, workcell communications, vision guidance, and conveyor tracking.

For common light-payload tasks such as part transfer, material handling/dispensing, and assembly, the Adept Cobra 600 offers maximum production flexibility with minimum development expense.

Specifications:

• Payload:	Burst:	Sustained:
0kg	0.47sec	0.56sec
2kg	0.55sec	0.62sec
5.5kg	0.63sec	0.74sec

- Reach: 600mm
- Payload: 5.5kg (12.1 lbs)
- Joint 4 Inertia (Max): 450kg-cm² (150lb-in²)
- Downward Force: 25kg (55lbs.)

- Robot Brakes:
 - Joints 1, 2 and 4: dynamic brake
 - Joint 3: electric holding brake
- Repeatability:
 - (x,y): ± 0.020 mm (± 0.0008 ")
 - (z): ± 0.01 mm (± 0.0004 ")
 - Theta: $\pm 0.03^\circ$
- Joint Range:
 - Joint 1: $\pm 105^\circ$
 - Joint 2: $\pm 150^\circ$
 - Joint 3: 210 mm (8.3" e;)
 - Joint 4: $\pm 360^\circ$
- Maximum Joint Speed:
 - Joint 1: 360°/sec
 - Joint 2: 672°/sec
 - Joint 3: 1,100mm/sec (43in/sec)
 - Joint 4: 1200°/sec
- Design Life: 60 Million Production Cycles
- Options:
 - AdeptForce VME
 - AdeptMotion
 - AdeptVision AVI
 - Robot-mounted camera bracket
 - Extended length cables (8 m)
 - Cleanroom Package (Class 10)
 - Solenoid Valve (2 @ 24VDC)
- User Connections
 - Electrical: 24 (12 twisted pairs)
 - Fieldbus: 2 pair w/MircoDIN
 - Pneumatic:
 - 2 @ 6 mm diameter
 - 3 @ 4 mm diameter
- Robot/Controller cables: 5 m (16.4')
- Weight: 34 kg (75 lbs)
- Power Consumption:
 - 3.6 kWburst mode
 - 1.9 kW sustained mode
 - 600 W robot only
- Available Controllers :
C-40; 1060; C-60; 1060+
- Operating Environment :
 - Robot:
 - 5-40°C (41-104°F)
 - 5-90% relative humidity (non-condensing)

Specifications subject to change without notice. 12/11/01

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