Experimental Conditions

Joint Encoder Resolution:	$3.835 \times 10^{-4} rad$
Equivalent Cylinder Displacement Resolution:	40 to 76 μm
Pressure Resolution:	$1.035 \times 10^{5} Pa$
Payload:	0 or $22.5 kg$

	Speed	Acceleration
Fast Point-Point Trajectory	$0.3 m/sec$	$1.5 m/sec^2$
Slow Point-to-Point Trajectory	$0.1 m/sec$	$0.2 m/sec^2$

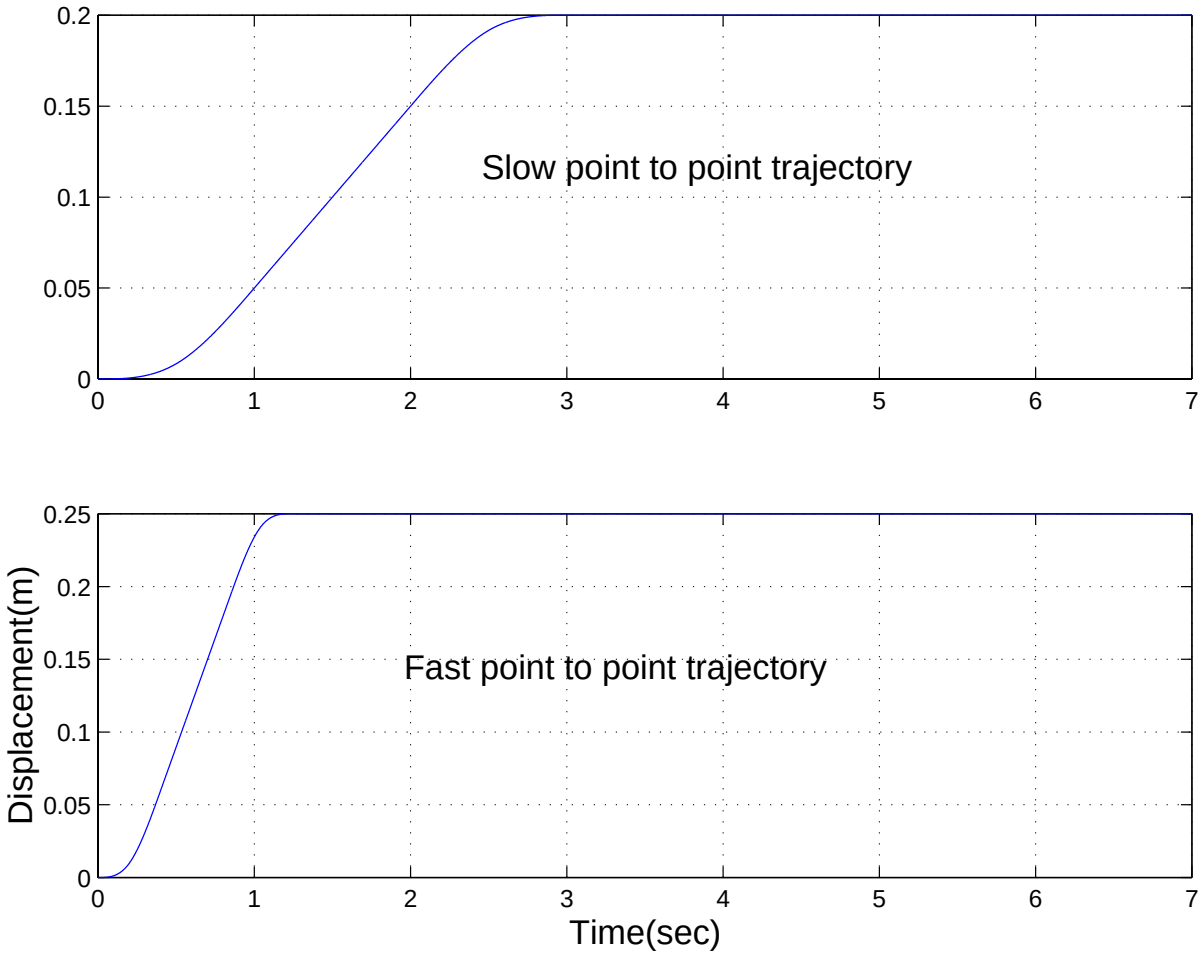

Figure 1: Point-to-point motion trajectories

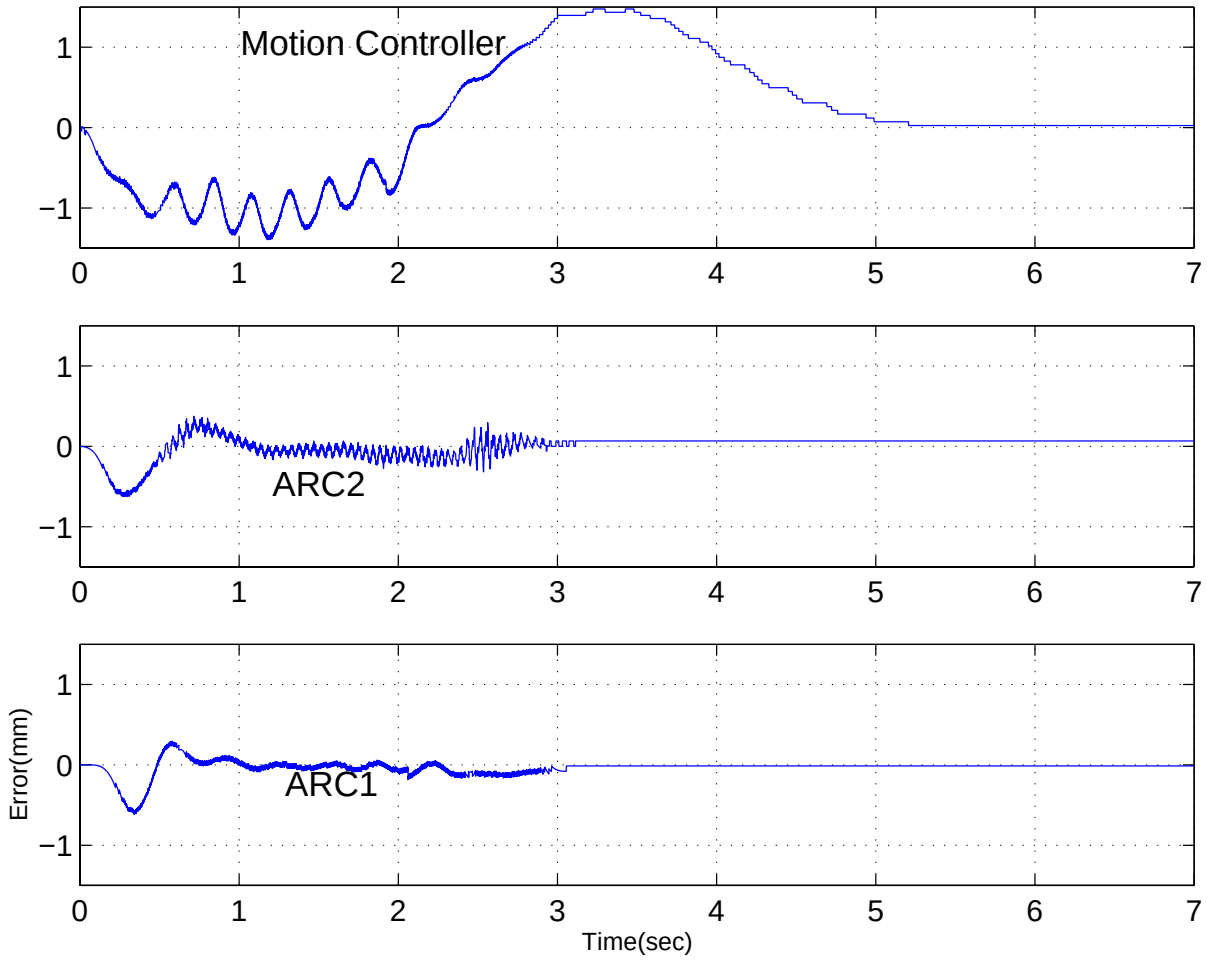

Figure 2: Tracking Errors in slow point-to-point motion without load

Comments:

The proposed ARC1 and ARC2 have a much better tracking performance than the Motion Controller in term of both transient and final tracking errors. Both ARC controllers reduce the final tracking error almost down to the measurement resolution level. In addition, since ARC1 employs time varying inertia compensation which captures the nonlinear effect of the swing motion, it achieves a better tracking performance than ARC2.

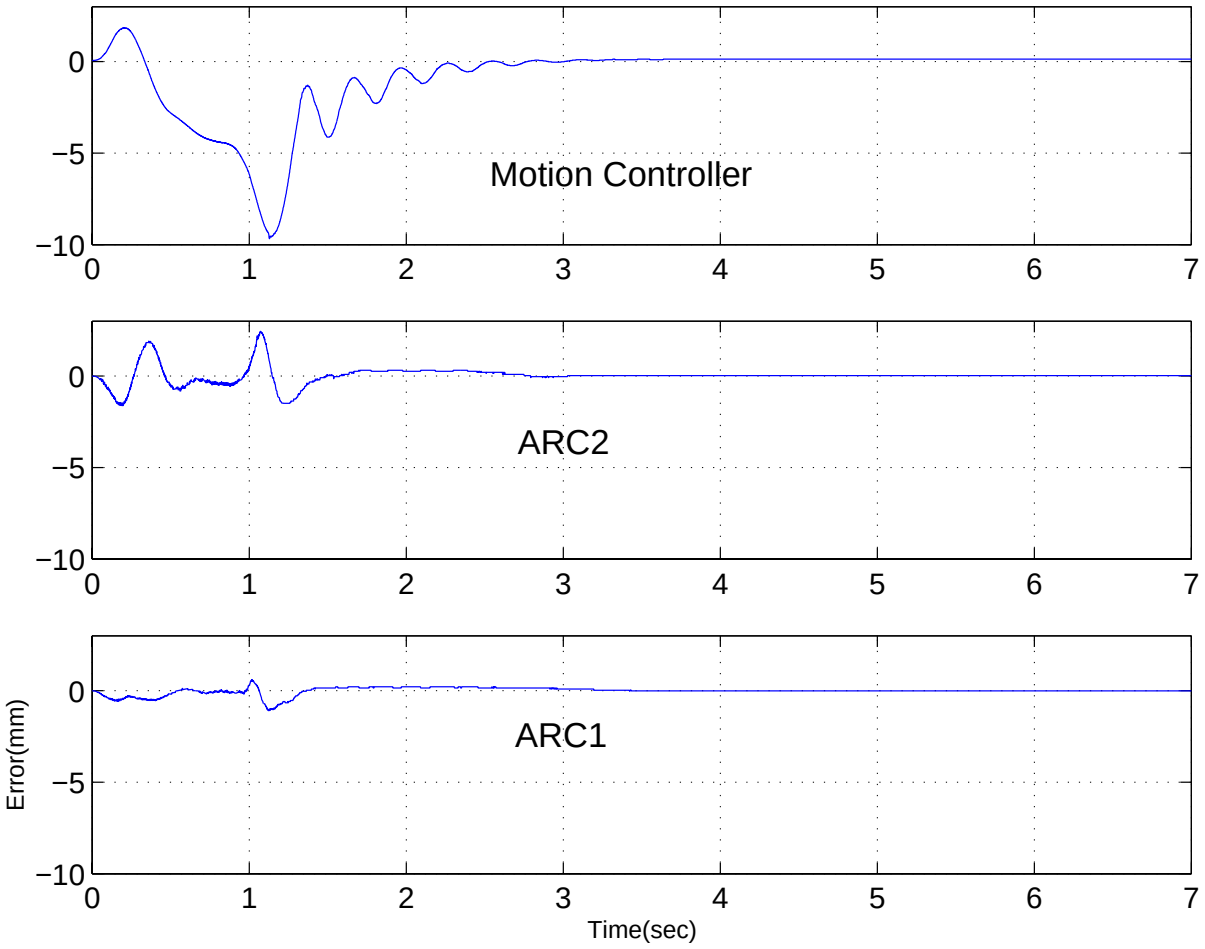

Figure 3: Tracking errors in fast point-to-point motion without load

Comments:

As seen, the Motion Controller cannot handle such an aggressive movement well and a large tracking error around 10mm exhibits during the transient. In contrast, the tracking error of the proposed ARC1 during the entire run is kept within 1mm. Furthermore, the tracking error goes back to the measurement resolution level very quickly after the short acceleration and deceleration periods. Again, the proposed ARC1 performs better than ARC2.

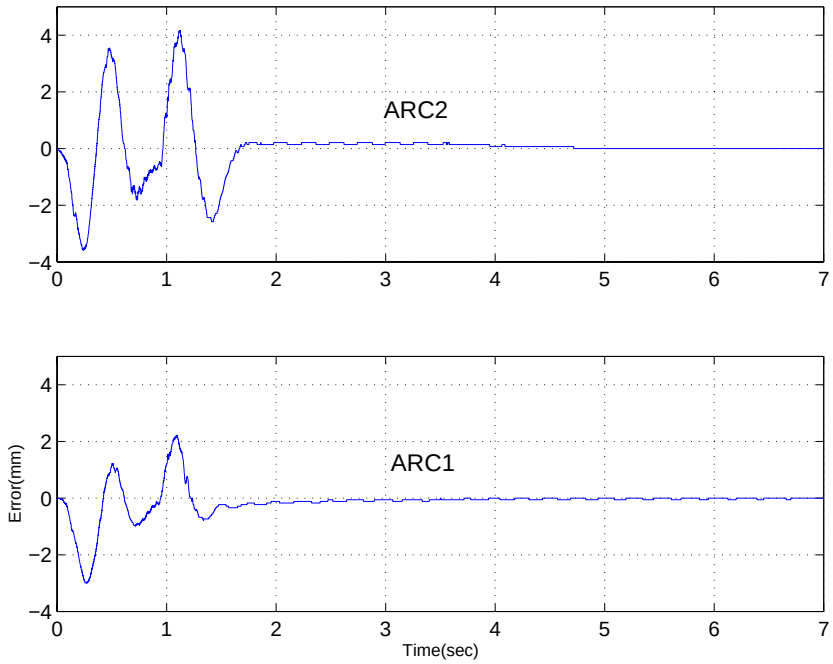

Figure 4: Tracking errors in fast point-to-point motion with 22.5kg load

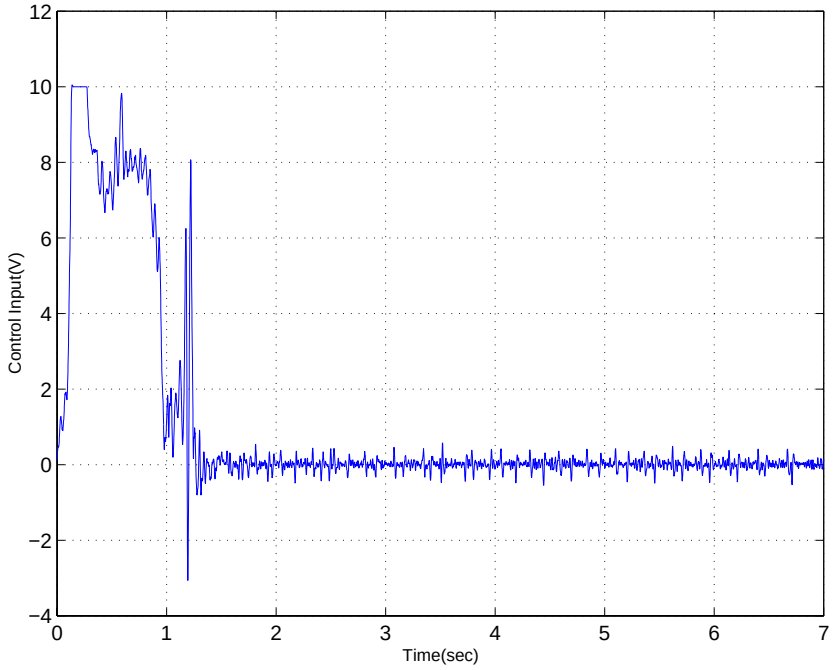

Figure 5: Control input in fast point-to-point motion with 22.5kg load

Comments:
To test the performance robustness to parameter variations, the system is run for the fast point-to-point trajectory with a 22.5 kg payload. Only ARC1 and ARC2 are compared as the performance of the Motion Controller is poor. As seen, although the control input of ARC1 is saturated during the initial transient due to the aggressive movement, the tracking error of ARC1 is till maintained within 3mm during the entire travel period. Furthermore, the tracking error reduces to the measurement resolution level quickly after the deceleration period. Again, ARC1 performs better than ARC2.