

DOCKING OF A RIGID SPACECRAFT WITH
UNRESTRAINED ORBITING FLEXIBLE STRUCTURE

T. R. Kane
Stanford University
Palo Alto, California

Purpose:

Establish a methodology for producing simulations of the docking of a rigid spacecraft with any unrestrained flexible structure.

Method:

Produce a detailed algorithm for the simulation of the docking of a rigid body with a nonuniform unrestrained beam.

Background:

Predocking and postdocking motions can be simulated with algorithms given in references 1 and 2.

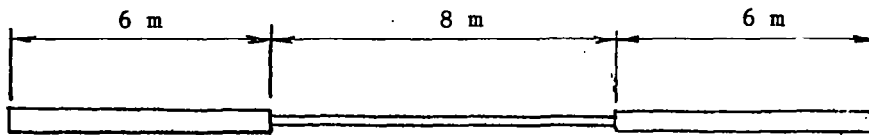
Tasks:

- (1) Determine the values acquired during docking by the variables characterizing the motions of the rigid body and the unrestrained beam.
- (2) Transform to the variables used in connection with the cantilever beam.
- (3) Perform simulations of the total process.

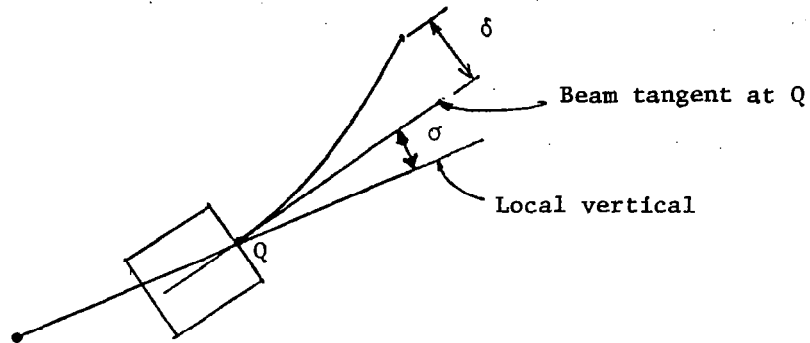
REFERENCES

1. Levinson, David A.; and Kane, Thomas R.: Simulation of Large Motions of Nonuniform Beams in Orbit. Part 1 - The Cantilever Beam. J. Astronaut. Sci., vol. 29, no. 3, July-September 1981, pp. 213-244.
2. Kane, Thomas R.; and Levinson, David A.: Simulation of Large Motions of Nonuniform Beams in Orbit. Part 2 - The Unrestrained Beam. J. Astronaut. Sci., vol. 29, no. 3, July-September 1981, pp. 245-275.

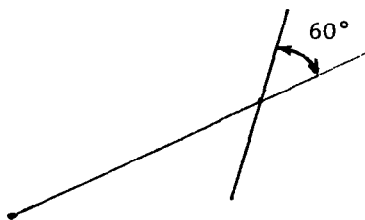
Beam



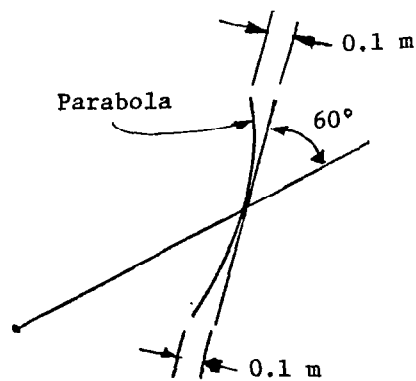
Variables

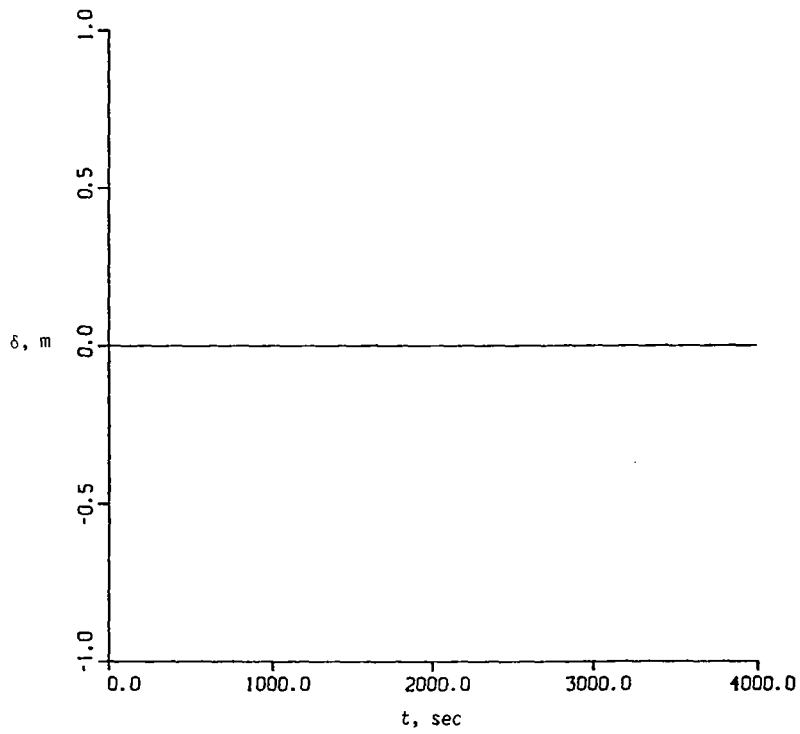
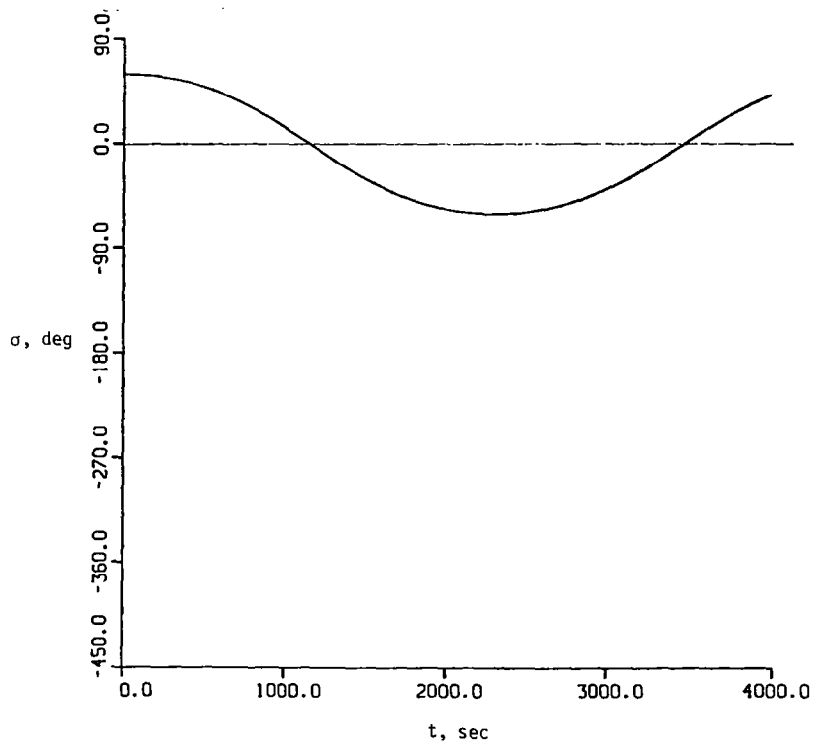


Initially undeformed beam

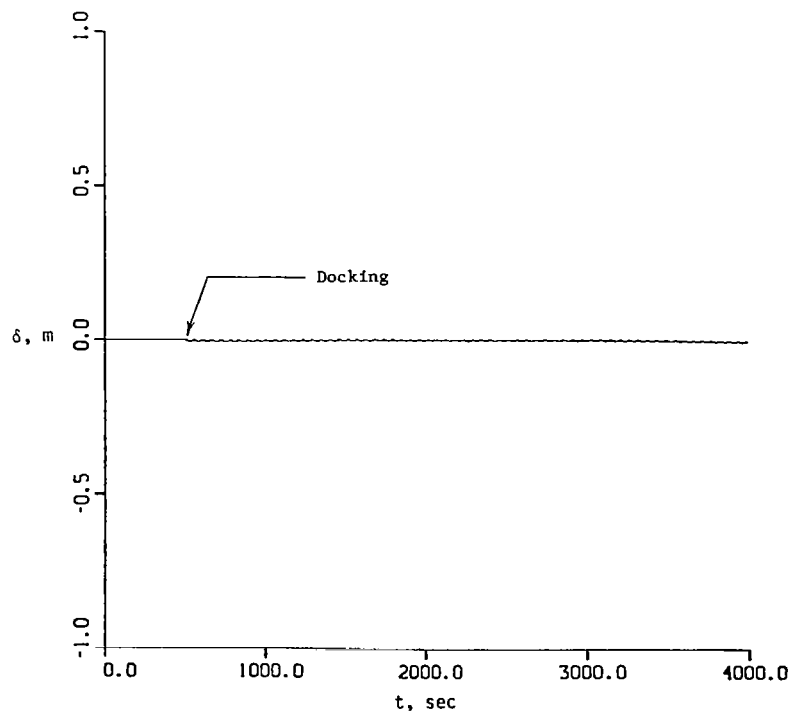
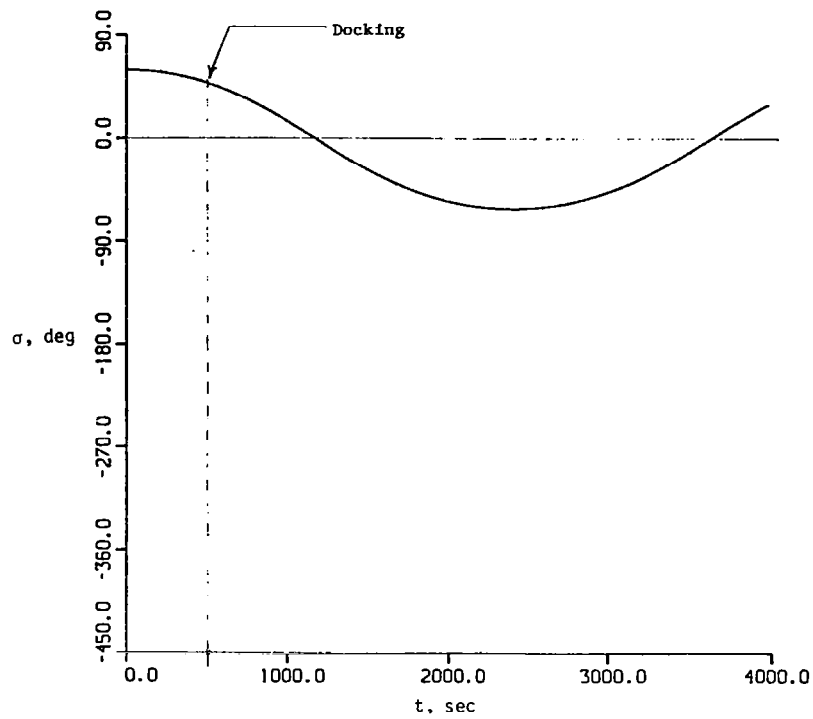


Initially deformed beam

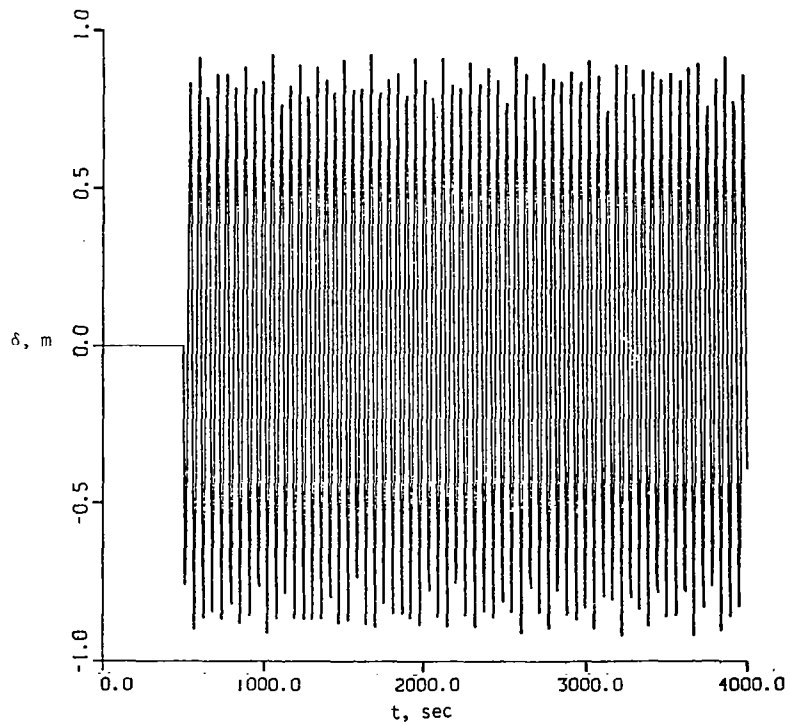
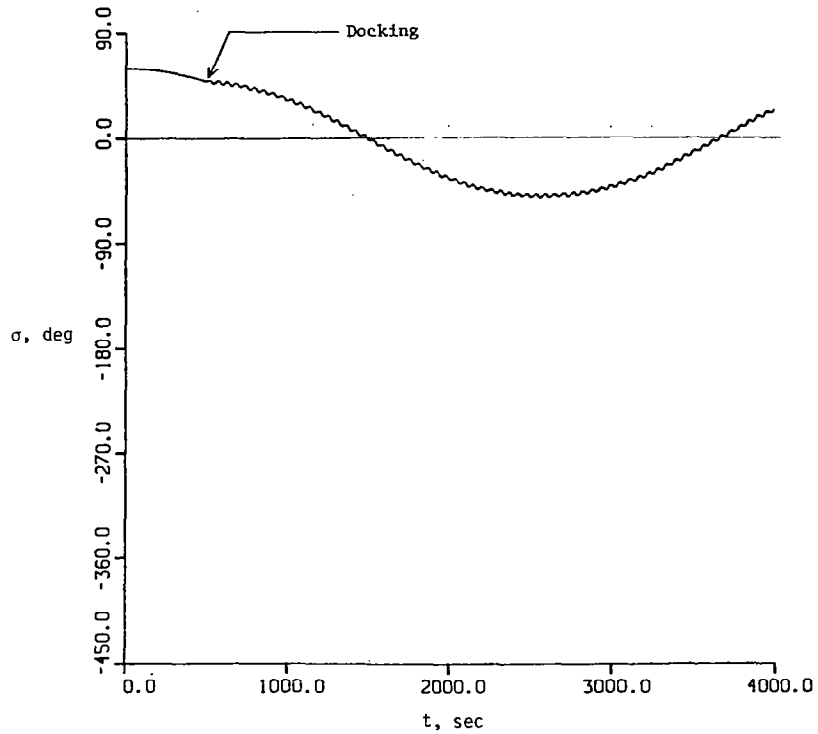




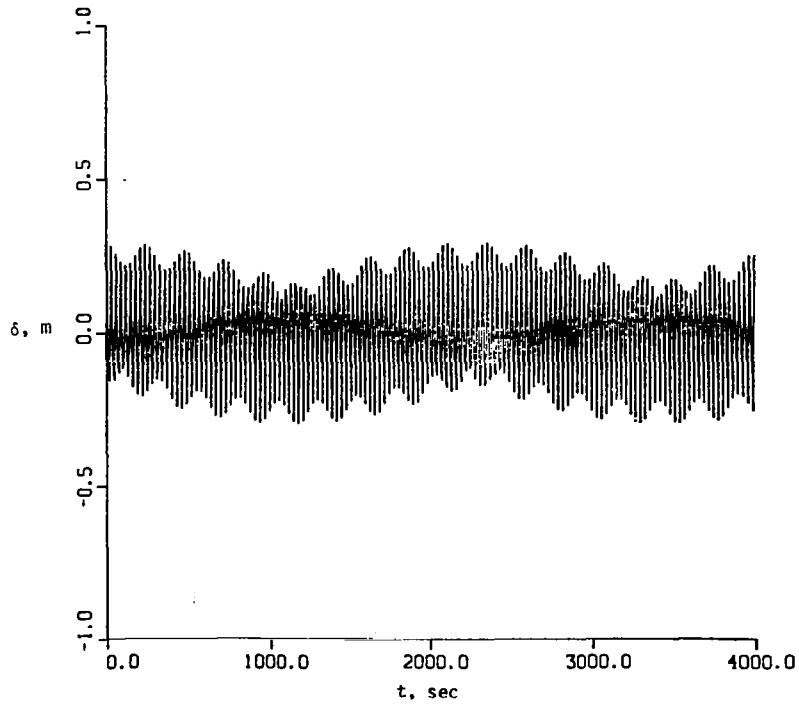
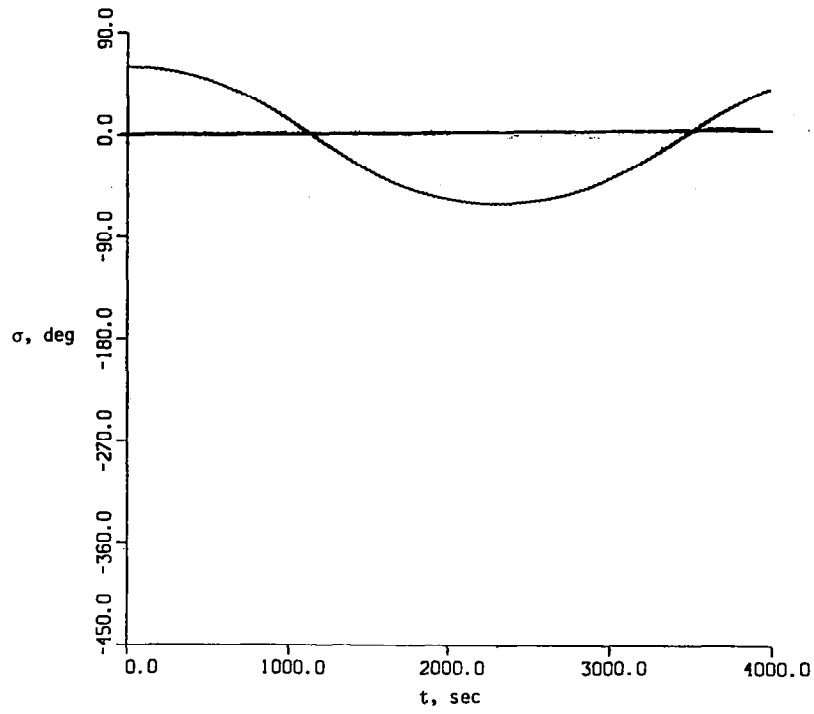
Libration of initially undeformed beam; no docking.



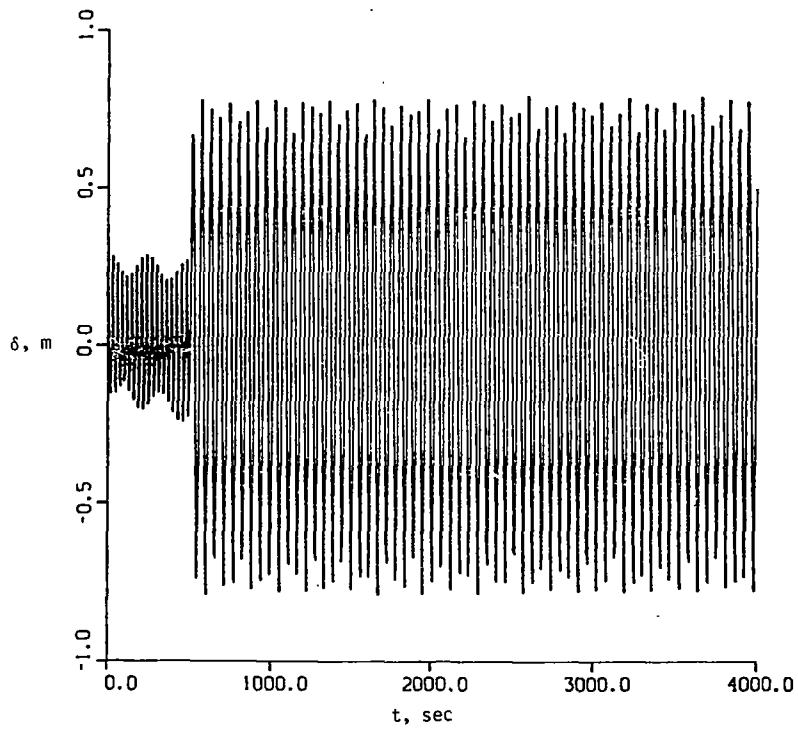
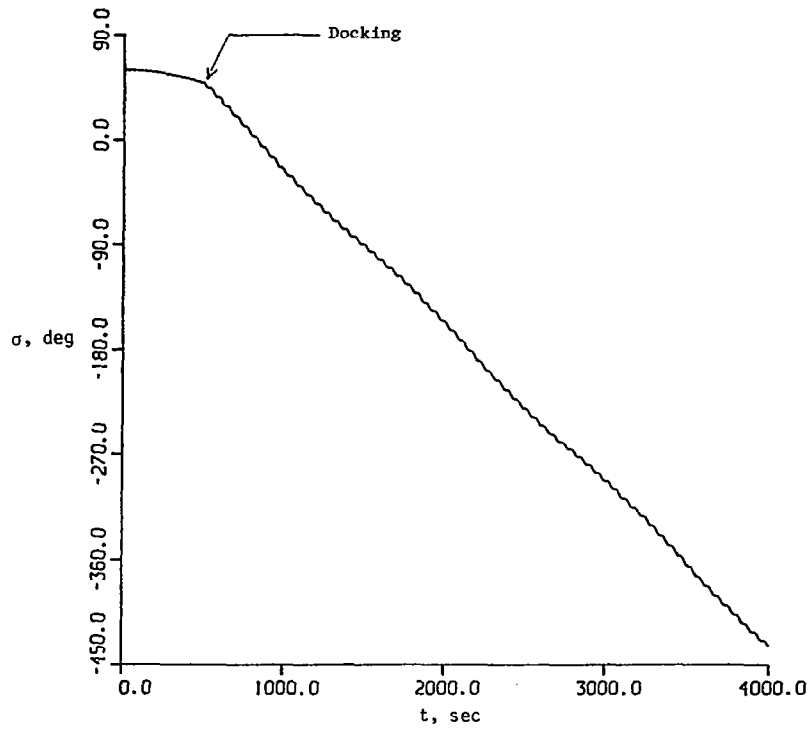
Libration of initially undeformed beam; perfect docking.



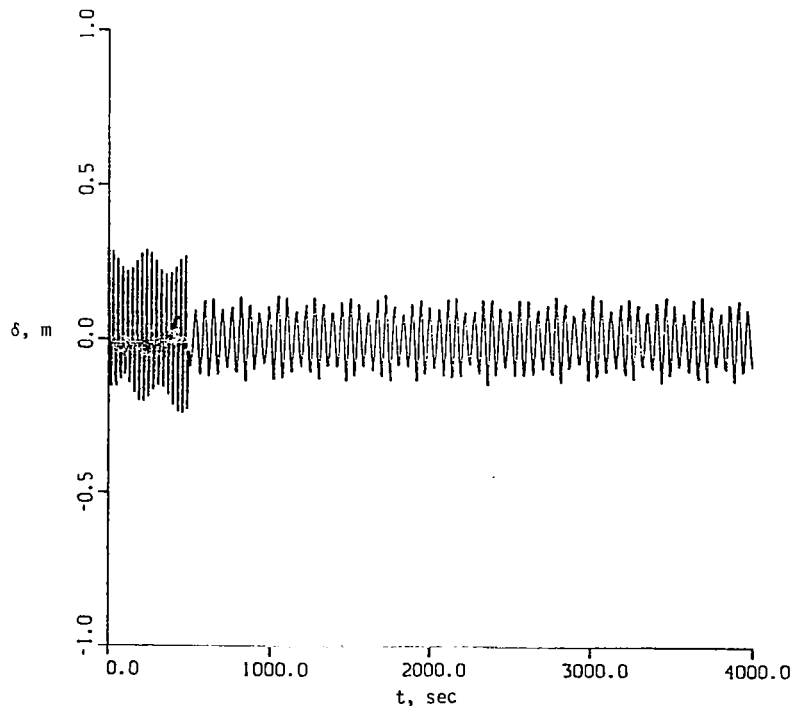
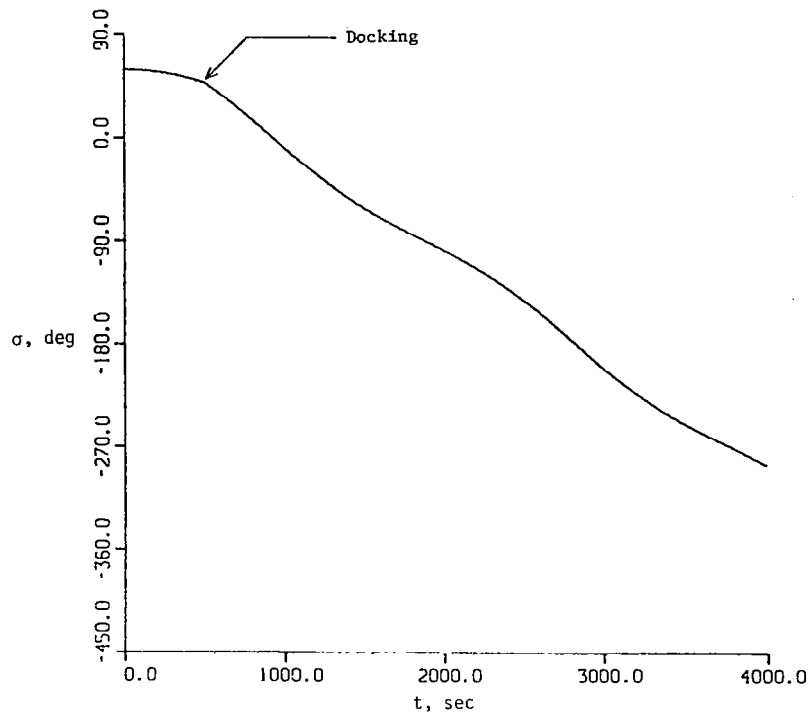
Libration of initially undeformed beam; imperfect docking. Velocity mismatch approximately 1 cm/sec; angular velocity mismatch approximately 0.01 rad/sec.



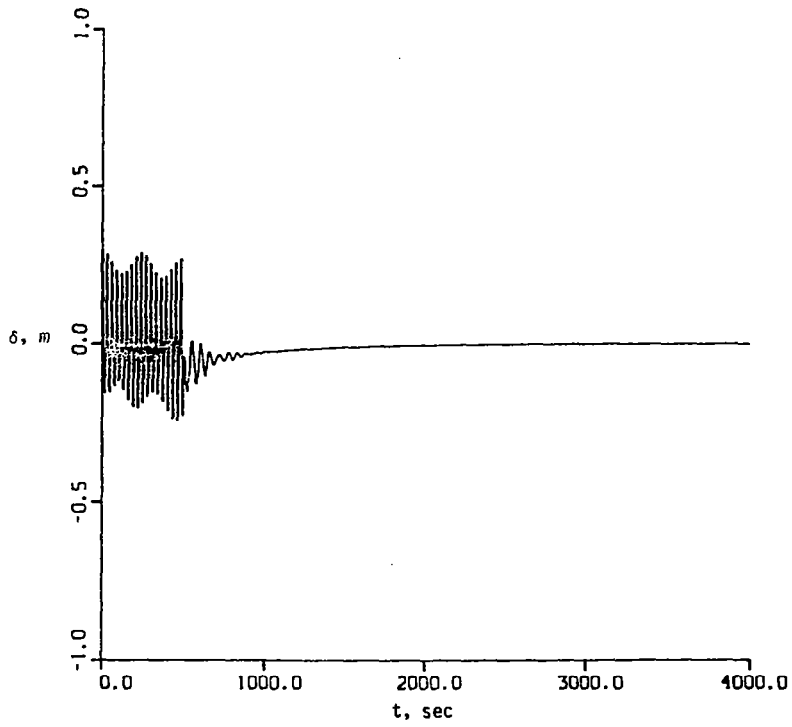
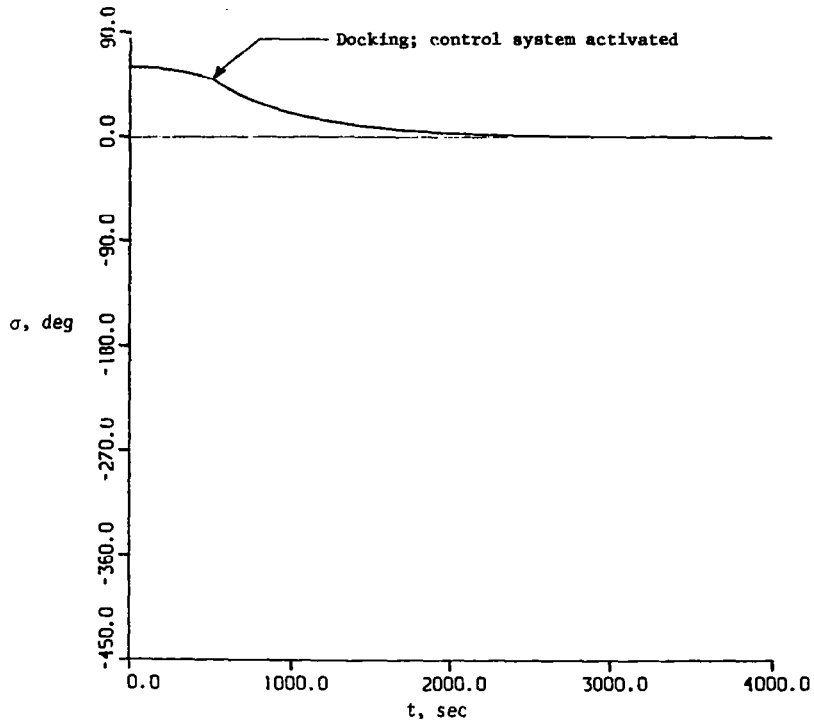
Libration of initially undeformed beam; no docking.



Libration of initially deformed beam; perfect docking.



Libration of initially deformed beam; imperfect docking.



Libration of initially deformed beam; postdocking control proportional to $-\dot{\sigma}$.