ICIEA 2022

16 - 19 Dec 22
Chengdu, China

ICIEA22-000259
Dynamic Analysis of Hinged Boom Based on Udwadia-Kalaba Equation1

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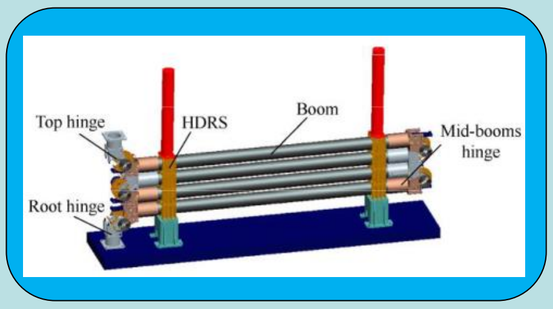
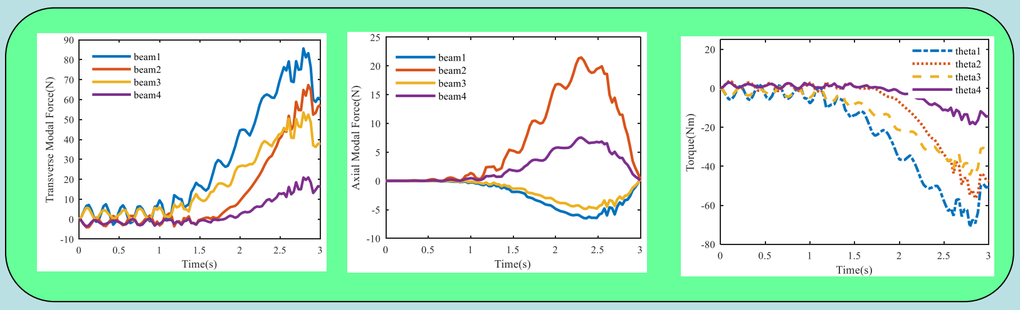
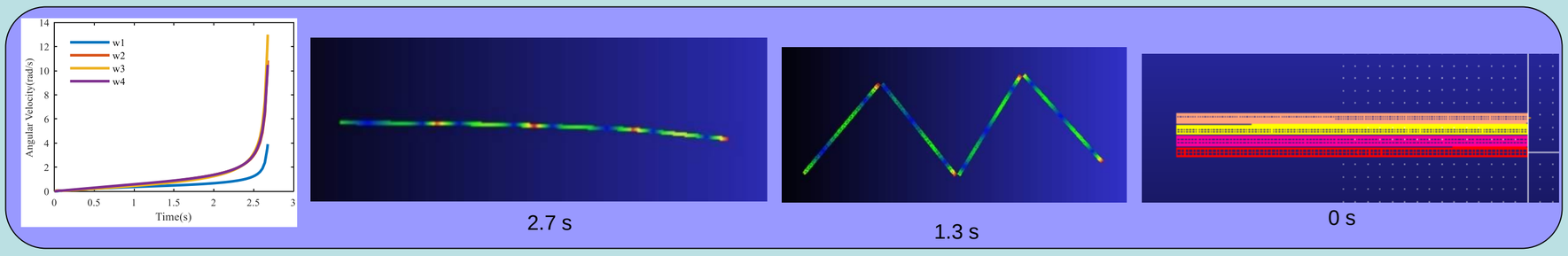
Simulation Results or Physical Model for Each Part



Part 1: Physical Model



Part 2: Simulation Results



Part 3: Model Verification

Part 1 shows the physical model which is composed of four hinges and four flexible beams. Part 2 shows the modal force of the four flexible beams and the torque of the four hinges. Part 3 shows the simulation verification ,.Useing ADAMS to verifiy the feasibility of the calculation results.

The boom is mainly affected by the transverse modal force, which is also the reason for the bending of the boom. The hinges from the root to the top require different torque, the root hinge requires the largest torque, and the top hinge requires the smallest torque. Substitute the solved torque into ADAMS for verification. Under the input driving torque, the deploying process is in line with expectations, and the angular velocity of the hinge is basically the same and twice the angular velocity of the root hinge.

Summary

This paper presents a dynamic analysis method for hinged boom based on the Udwadia-Kalaba Equation. The method is simple and practical, avoids the calculation of complex parameters such as Lagrange multipliers, and simplifies the calculation process. Due to the simple structure of the hinged boom, the AMM is used to derive the dynamic equation of the boom, and according to the tree topology multi-body theory, the dynamic equations of the four booms are grouped to obtain the hinged boom equation. Finally, according to the Udwadia-Kalaba Equation, the torque required by each hinge of the hinged boom is obtained. And Adams is used to carry out the dynamic simulation analysis of the hinged boom, which verifies the feasibility of the method. According to the simulation results, hinged boom can deployed by a predetermined trajectory and speed.