# Design & simulation of a Stewart Platform for Shipboard Aircraft Stabilisation

By Ritwik Shankar
Application number:2330394
Dept. Of Aerospace Engineering
IIT Kanpur

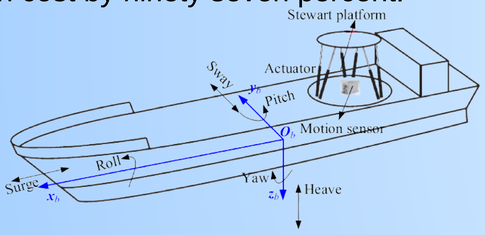
In guidance of Dr. Abhishek
Prof. Dept of aerospace engineering
IIT Kanpur

## ABSTRACT


- I aim to develop a cost-effective alternative to the existing **Stewart platform** currently priced at approximately **40,00,000 INR,** the cost posing a significant barrier to its widespread utilization in the aerospace field.
- This project recognizes the immense utility of the Stewart platform in various applications, ranging from **aircraft simulators** to actual **Navy aircraft carriers.**

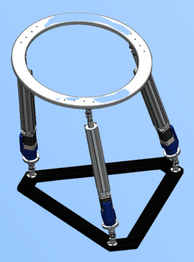

## PROBLEM STATEMENT

To design a **cost-effective Non-response Stewart platform** for shipboard aircraft stabilisation which works on ocean waveform feed,while simultaneously lowering its production cost by ninety seven percent.

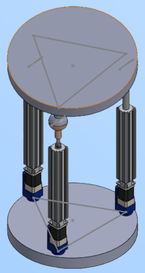



## APPROACH

- Several research papers were studied to gain insights into the dynamics and kinematics of the Stewart platform, which included the classic **6-actuator 'Hexapod' platform**,**3 servo-3 actuator platform** and **6-servo** platform to find out the most optimised one.
- Solidworks models were created for **3 actuators** and **4 actuator model** to test out compatibility and usage. 3-Leg was preferred because of more range of motion.



*3-leg actuator with Universal joints.*

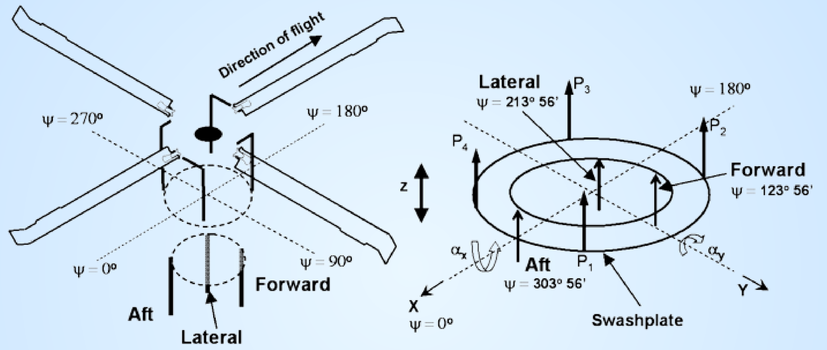


*3-leg with ball-socket joints(equilaterial traingle formed)*

- By using **Simulink with the help of Simscape multi-body,** the models were tested, but **no unique solution** was obtained at various orientations, so the model had to be re-designed to fit the constraint issues caused.

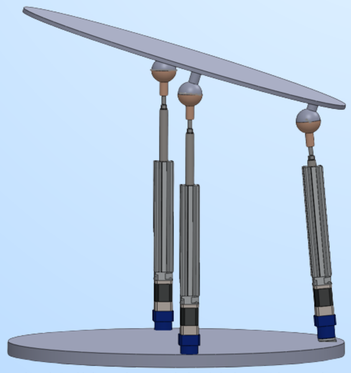
## INSPIRATION FROM SWASH PLATE

- A mechanical component known as a **swashplate** converts input from the helicopter's flight controls into motion of the main rotor blades.

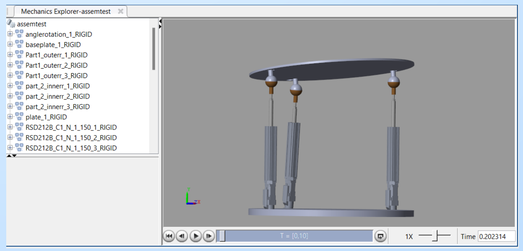



*UH-60 Swashplate model from research paper of Dr Abhishek*

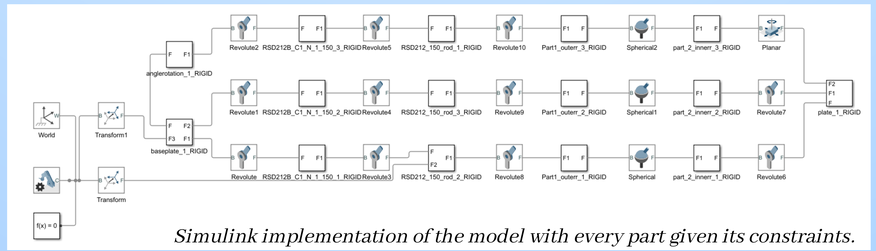
- The Cad model was built to test out the utility of this model and was tested in Simulink to under more about range of motion.
- Calculations were done in accordance with the research paper.



*Final Solidworks model with lateral at 5 degrees*



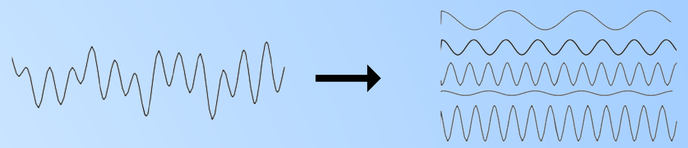

*MATLAB SCREENSHOT OF SIMULATION OF THE MODEL*




*Simulink implementation of the model with every part given its constraints.*

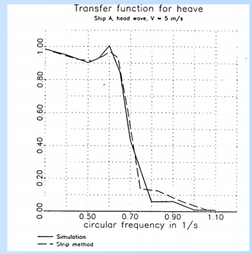
## WAVEFORM DATA

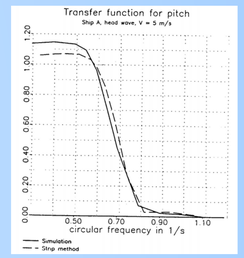
- Simultaneously we had to get ocean waveform date to feed it to the platform for it to work.Ocean waves were brought down to individual sine and cosine waveforms.



*Random wave to Decomposition to set linear waves*

- With the help of online articles wave simulation and data was acquired.



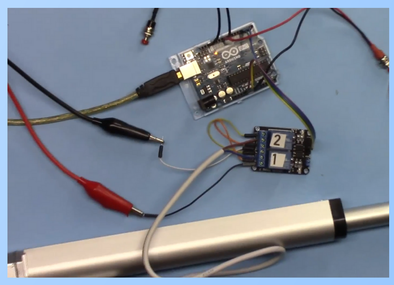




*Experimental Data was taken from already done research and some examples are given above*

## FABRICATION

- Actuators were ordered and tested in their range of motion and Arduino Uno was used as the controller. Compatibility of movement of all 3 actuators with the base plate is being worked upon in the Arduino code.

*ARDUINO CONNECTIONS WITH ACTUATOR*



- After all the constraints are sorted in the code,The plate will be 3D printed and will be ready to use.
- A possible response platform on the gyroscopic data will also be researched upon,taking inspiration from **self level** Arduino RC planes.