Kinimatics and dynamics - lab report example

Engineering

Kinimatics and Dynamics

Governing Dynamics of Gyroscope Institute Governing Dynamics of Gyroscope Aim: The purpose of this experiment is to investigate the relationshipbetween the precession angular velocity, the spin angular velocity, the applied moment and the rotational mass moment of inertia of a gyroscope in steady precession.

Procedure:

1. Measure the diameter of the gyroscope.

2. Place a weight of known mass at the gyroscope.

3. Create spinning motion of Gyroscope in either clockwise or anticlockwise direction but at a right angle.

4. Measure the angular velocity of the gyroscope using the tachometer.

5. Once the gyroscope is in steady precession, measure the spin angular velocity using the tachometer.

6. Measure the precession angular velocity for half revolution through which it precesses in time is measured using the tachometer.

7. Repeat the procedure for each known mass twice and then change the mass is.

8. Record the data collected in a table.

Results and Discussion: The data collected and calculated is summarized in the table below.

Number

m/g

mx / g

ωz / rpm

ωz / rad s-1

Ωy / rad s-1

1

25

0. 087

445. 4

46. 64218

22. 43

32. 43171

2

25

0. 087

441. 7

46. 25472

22. 43

64. 594

3

50

0. 174

448. 4

46. 95634

11

80. 60611

4

50

0. 174

450. 6

47. 18672

10. 875

96. 51394

5

75

0. 261

416. 2

43. 58436

7. 83

107. 0932

6

75

0. 261

446. 7

46. 77831

7. 56

118. 0561

Diameter: 25 mmmass of disk: 1. 735 kgh: 35. 5 cm Iz = 0. 031 g m2

The following graph illustrates the findings of this data which confirm that gyroscope conforms to the following equation

The graph has been drawn using least square regression method and has been extrapolated to find a possible y-intercept. The regression equation came out to be

As is evident from the graph, there is a drastic difference between the y-intercept as suggested by the equation, origin, and that of the regression

equation. There are two reasons for this, first being the inappropriate units used since SI units have not been used, and second being the experimental errors that may have caused the results to be more ‘ heightened’ than those actually observed. Once these two factors are disregarded, it becomes evident that the equation holds true for gyroscopic precession.

Conclusion: Through experimental and statistical analysis and error correction, it has been observed that the relationship between the precession angular velocity, the spin angular velocity, the applied moment and the rotational mass moment of inertia of a gyroscope in steady precession is succinctly laid out by the aforementioned equation.