Dynamic Force Analysis

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1 Introduction

Mechanical systems involving the interaction of various components play a crucial role in understanding and optimizing the performance of machines. In this lab report, a dynamic force analysis will be conducted for an opposed two-cylinder crank/connecting rod/slider arrangement.

1.1 Objectives

The primary objective of this analysis is to delve into the kinematic and kinetic aspects of the system. Through numerical and symbolic calculations, we aim to determine key parameters, including angular velocities, angular accelerations, transmitted forces, input torque for constant angular velocity, and out-of-balance forces. These parameters will be crucial in comprehending the system's behavior and optimizing its design.

The investigation encompasses a time-dependent analysis covering two complete revolutions of the crank, and the obtained results will be graphically illustrated.

1.2 Approach

The analysis will be carried out utilizing computational software, namely MATLAB, and analytical methods. The analytical equations developed in class will be employed to conduct a comprehensive analysis of the system, particularly in determining the out-of-balance forces. The MATLAB software will be used to numerically solve the system's equations of motion.

This dual approach, combining computational tools and analytical methods, ensures a robust and comprehensive understanding of the mechanical system under consideration.

2 Literature Review

In the domain of dynamic force analysis for levitated planar actuators, Rovers[1] makes a substantial contribution. Their paper meticulously explores the dynamic forces and torques exerted within a moving planar actuator, shedding light on crucial aspects of its behavior.

The work by Korayem[2] stands out for its notable significance in the dynamic analysis of tapping-mode Atomic Force Microscopy (AFM). The paper focuses specifically on capillary force interactions, enriching our understanding of the intricacies involved.

Similarly, Williams[3] contributes significantly to the field with a study centered on the dynamic force analysis of planar mechanisms. The insights provided in this work are valuable for comprehending the nuanced behavior of such systems.

Cheng-ge[4] adds to the discourse with noteworthy research on the dynamic force analysis of power capacitors within a frame context. The detailed exploration carried out in this paper makes a substantial contribution to the relevant body of knowledge.

Lastly, the work by Schütte[5] holds considerable importance, delving into the discussion of ConDroid, a tool designed for targeted dynamic analysis of Android applications. This contribution extends the scope of analysis beyond mechanical systems, showcasing the interdisciplinary nature of dynamic force examination.

Collectively, these papers form a robust foundation for the comprehensive analysis of the mechanical system under consideration.

[1] Rovers, (2012)
[2] Korayem, (2011)
[3] Williams, (1981)
[4] Cheng-ge, (2010)
[5] Schütte, (2015)

3 Methodology

4 Analysis

Assumptions made in the analysis include treating each linkage as a slender rod, neglecting the effects of gravity and friction, and confining all motion to a common plane. It is imperative to document and articulate any additional assumptions deemed necessary for the analysis.

5 Discussion

6 Conclusions

7 References

1. Rovers, J., Jansen, J., Compter, J. & Lomonova, E. (2012). Analysis Method of the Dynamic Force and Torque Distribution in the Magnet Array of a Commutated Magnetically Levitated Planar Actuator. IEEE transactions on industrial electronics (1982. Print).

2. Korayem, M., Kavousi, A. & Ebrahimi, N. (2011). Dynamic analysis of tapping-mode AFM considering capillary force interactions. Scientia Iranica.

3. Williams, R. & Rupprecht, S. (1981). Dynamic force analysis of planar mechanisms. Mechanism and Machine Theory.

4. Cheng-ge, H. (2010). Discussion on Frame Dynamic Force Analysis of Power Capacitor. Power Capacitor & Reactive Power Compensation.

5. Schütte, J., Fedler, R. & Titze, D. (2015). ConDroid: Targeted Dynamic Analysis of Android Applications. 2015 IEEE 29th International Conference on Advanced Information Networking and Applications.