Hummingbird-Inspired High-Speed Flight Deceleration

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Abstract

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Keywords: Flight, Bio-inspired, Graded elasticity coatings, Functionally graded materials

1. Introduction

Of all the various types of robotic locomotion, a dichotomy can be drawn such that there are two main categories, robots that require pre-established infrastructure and robots that do not. A rumba requires flat surfaces to traverse, where as DARPA's dog can navigate the uneven surface of a grassy hill. Robots that do not require specific environmental geometry can be deployed in countries that have limited infrastructure to deliver important supplies. For disaster relief, supply delivery via all-terrain, long-distance autonomous vehicles can be critical.

This paper outlines a proposal for a high-velocity aerial robot drawing inspiration from hummingbirds. The robot will use near-vertical take-off, requiring no runway. The bio-inspiration comes from the manner in which humming-birds rapidly decelerate. When hummingbirds are in mating season, the males attract females executing a looping display dive reaching speeds of up to approximately 27 meters per second, Clark (2009). The design will incorporate an initial acceleration mechanism to propel the robot to a high altitude. Once the apex of the trajectory is reached, hummingbird-inspired wings and tail feathers will be deployed to mimic the deceleration.

The basic design of the robot will be broken up in to two main sections: **1)** the initial acceleration mechanism and **2)** the deceleration mechanism. A simulation will first be made, and as a stretch-goal, a prototype will be assembled.

1.1. Acceleration mechanism

2. Formulation of the problem

3. Method of solution

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4. Implementation

The algorithm, the numerical solution etc.

Figure 1: Example of a chart

5. Numerical results and discussions

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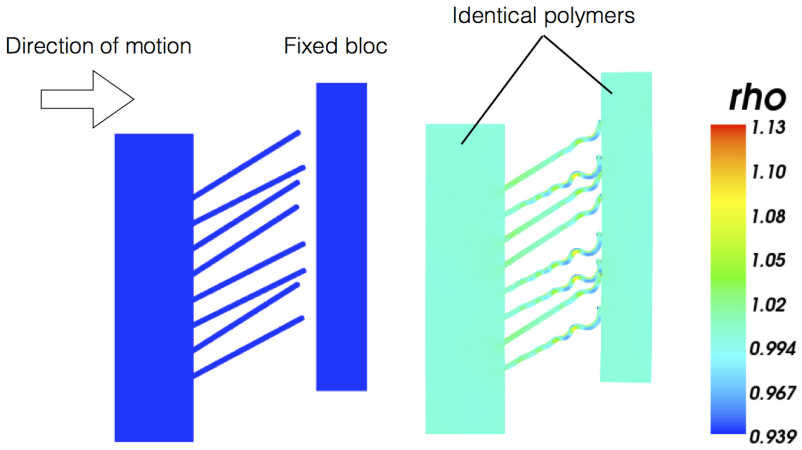

(a) undeformed array of fibers (b) deformed array of fibers

Figure 2: array of soft compressible viscoelastic polymer fibers compressed by an elastic wall the colors represent non-dimensional particle density, where 1 is the density of the undeformed fibers

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Acknowledgement

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References

References

Clark, C.J.. Courtship dives of annas hummingbird offer insights into flight performance limits. Proceedings of the Royal Society 2009;.