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(G*) Designing a Magnetic Micro-Robot for Transporting Filamentous Microcargo

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In recent years, there has been a surge of interest in minimally invasive medical techniques, with magnetic micro-robots emerging as a promising avenue. These microrobots
possess the remarkable ability to navigate through various mediums, including viscoelastic and non-Newtonian fluids, thereby facilitating targeted drug delivery and medical interventions. However, while many existing designs draw inspiration from micro-swimmers found in biological systems like bacteria and sperm, they often rely on a contact-based approach for payload transportation, which can complicate release at the intended site. Our project aimed to explore the potential of helical micro-robots for non-contact delivery of drugs or cargo. We conducted a comprehensive analysis of the shape and geometric parameters of the helical micro-robot, with a specific focus on its capacity to transport passive filaments. Through our examination, we propose a novel design comprising three sections with alternating handedness, including two pulling and one pushing microhelices, to enhance the capture and transportation of passive filaments in Newtonian fluids using a non-contact method. Furthermore, we simulated the process of capturing and transporting the passive filament and evaluated the functionality of the newly designed micro-robot. Our findings offer valuable insights into the physics of helical micro-robots and their potential applications in medical procedures and drug delivery. Additionally, the proposed non-contact approach for delivering filamentous cargo holds promise for the development of more efficient and effective microrobots in medical applications.

Keyword-1

Microrobot

Keyword-2

Fluid mechanics

Keyword-3

Sperm

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