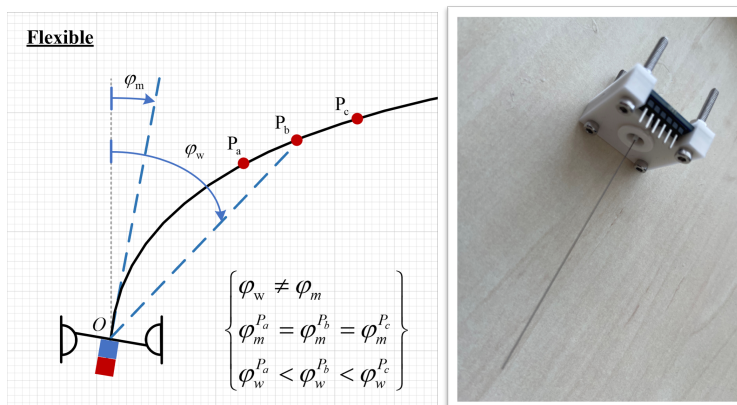


Dynamic contact estimate along a whisker-inspired tactile sensor

Description

An intriguing common feature among rodents is their whiskers, which they can actively move to sense the contact around their environment. These whiskers serve various functions such as extracting contour from object, providing location estimate for robot, recognizing textural feature, and actively avoiding collisions. Basically, it offers a non-intrusive tactile-based perception for robots, particularly beneficial in unstructured, cluttered, and visually impaired environments. Achieving real-time contact estimates and ensuring a robust mechanical design are vital for such a sensor. Previous approaches have often relied on 6-axis force/torque sensors [1], piezo resistors [2], or other force-related sensors. However, these solutions are typically either bulky and challenging to scale down. In contrast, a magnetically transduced whiskers [3] offers a more compact and easily integratable solution, capable of forming arrays with parallel whiskers. Nonetheless, accurately modeling contact movement and localizing it along the whisker shaft based on magnetic flux changes rely heavily on a robust design. Our current method based on state estimation suffered from a dynamic error [4] due to the lack of prior knowledge on object's shape. A ringing oscillation and measurement drifting are also causing an issue on estimate.



Tasks

In this project, you will further develop a magnetic transduced whisker sensor, build contact estimation and implement it on a robot arm platform to perform a contour reconstruction on object. Specially, your task will include: 1). further improve our current sensor design to ensure its robustness and give a full evaluation on its performance; 2). build solution to compensate the dynamic error of a contact estimate method based on real-time state estimation; 3). implement the method on real robot platform and extract the object contour.

[1] Tactile sensing with whiskers of various shapes: Determining the three-dimensional location of object contact based on mechanical signals at the whisker base[J]. *Soft robotics*, 2017; [2] A small-scale, rat-inspired whisker sensor for the perception of a biomimetic robot: Design, fabrication, modeling, and experimental characterization[J]. *IEEE Robotics Automation Magazine*, 2022; [3] A magnetically transduced whisker for angular displacement and moment sensing[C]. 2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS); [4] Whisker-inspired tactile sensing for contact localization on robot manipulators[C]. 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).

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Type:

MA

Research area:

 tactile sensor, biomimetic
rodent, robotics, state estimate,
non-intrusive perception

Programming language:

C++ or Python

Requirements:

 High self-motivation and passion
for robots; At least six-month
working time; ROS, Python and
C++ (optional) programming
experiences; Familiar with
real-time state estimation and
experience on mechanical
structure design.

Language:

English

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