Estruturação do Site e Documentação da Biblioteca de Processamento de Imagens Biomédicas (BIAL)

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Overview

The goal is to build and validate a spacial drill. It digs by doing a reciprocating motion instead of rotation, inspired by the *Sir ex Ductile* wasp species.

Why not use standard proven designs?

Out of Earth there is no guarantee that gravity will pull down a drill strongly enough to make it dig. This design, however, does not need anything pulling it down.

What has been done?

Validation of the design's controllability, and implementation of a control system. This is what is discussed here.

Implementation

The implementation can be logically separated into three parts: theoretical calculations, mechanical design and programming.

Theoretical calculations

The overall rig is composed of the motor plus the test drill rig (See Fig. 1).

Figura: Front view of the test rig with a drill mounted.

The mathematical model of the rig consists of: a standard model of electric motors available in the literature, coupled with a specific location-based model of the apparatus developed for this analysis. Using this model, the optimum parameters for the system were calculated based on the goal that all errors should be minimised. The implementation and programming were based in these results.

Mechanical design

To assemble the electric motor into the test rig, two mechanical parts had to be designed. They can be seen in Figs. 2 and 3.

Figura: Axis attachment for the test rig.

Figura: Ring attachment for the test rig.

Programming

With the electro-mechanical apparatus all set, the micro controllers were programmed: an Arduino board and an ESCON controller chip. They can be seen in Fig. 4.

Figura: Test rig controllers: Arduino (dark blue) and ESCON (black box)

The ESCON is a high-precision control unit that is not directly programmable: it saves and processes all theoretical results for use. The Arduino, however, has been fully programmed to interface a computer station with the system via software implemented for this purpose (Fig. 5).

Figura: Drill interface software.

Also, the Arduino-ESCON programming includes safety procedures to shutdown the system whenever the motor is stalling, ensuring safer operating conditions.

Results

The controllability sought was achieved as evidenced in Fig. **??**, where the error descends until a near zero value and stabilises about this point.

The constant rate at which the error decreases guarantees that there will be enough time for a failure detection.

Final considerations

Future works

- Develop a mathematical model for the ground resistance: this can significantly improve control performance.
- Further development of the constructed control system and models.

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