MODELING AND CONTROL OF MCKIBBEN ARTIFICIAL MUSCLE – APPLICATION OF MODEL PREDICTIVE CONTROL AND GENETIC ALGORITHMS

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1 Members of GuIT (Gruppo Italiano Utilizzatori di TeX e LaTeX)

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ACRONYMS

DRY Don't Repeat Yourself

API Application Programming Interface

UML Unified Modeling Language

1 INTRODUCTION

1.1 BACKGROUND AND MOTIVATION

The current state of the art in hydraulic actuators consists almost entirely of oil driven valves, pistons and motors. However, this kind of actuator cannot be used in some particular applications, such as power assist systems and rehabilitation: they have significant heaviness and rigidity, because of their mechanical structure and motorization [1]. In this context, it is problematic to share a robot working space with humans around it, and so this kind of actuator cannot be used to actuate orthotics.

McKibben muscles were invented by Joseph L. McKibben to motorize pneumatic art orthotics. They in general consist of an inner rubber tube enclosed in a braided outer nylon sleeve. These muscles can be used as actuators of rehabilitation systems due to the following advantages:

- Light weight
- High power to weight ratio
- High flexibility
- Low cost
- Low environmental impact

However, there are drawbacks: it is well known that the muscle has poor control performance due to the existence of strong nonlinearities, such as hysteresis and saturation characteristics. Furthermore, the wear of the materials (nylon sleeve and rubber tube) may cause a shorter lifetime with respect to other actuators.

1.2 MODELLING OF MCKIBBEN ARTIFICIAL MUSCLE

2 COMPOSITION OF THE THESIS

3

TAP WATER-DRIVEN MCKIBBEN ARTIFICIAL MUSCLE

4

MODELLING OF MCKIBBEN ARTIFICIAL MUSCLES

5 CONTROLLER DESIGN

Part I

APPENDIX

APP A

BIBLIOGRAPHY

[1] Pierre Lopez Bertrand Tondu. *Modeling and Control of McKibben Artificial Muscle Robot Actuators*. IEEE Control Systems Magazine, 2000.