Coursework: Serial Robot Kinematics

This document explains the requirements of the assessed practical work for the UFME7K-15-M Intelligent and Adaptive Systems module. Although you are encouraged to share your ideas and discoveries with each other, you should remember that this is an individual piece of work.

The description of work below is divided into that which you are expected to carry out in order to attain an adequate pass mark in this coursework, followed by suggestions for topics you might work on in order to demonstrate a fuller understanding of the more advanced parts of the topic and your capability to conduct a deeper investigation. This additional work is expressed here in a much more open-ended manner, concomitant with Master level study.

This assignment is to be submitted as a report, details of which are given below. This report is worth 100% of the marks for the Coursework element of the module.

The deadline for submission of your report is 21st April 2016.

PART III:

TO ATTAIN AN ADEQUATE PASS CARRY OUT THE FOLLOWING:

A. From material covered during lectures, lab exercises and examples, you are to complete the following tasks:

1) Derive an Adaptive Neuro-Fuzzy Inference System (ANFIS) representation of the inverse kinematics for the Lynxmotion arm.

Use MATLAB's Fuzzy Logic Toolbox, lecture material and further reading. Include all your investigations and report this.

2) Analyse and compare the performance of the ANFIS approach to an analytical solution of the inverse kinematics.

B. Complete the following programming tasks:

1) Enhance your MATLAB simulation developed in part I to include use of the Fuzzy Logic toolbox ANFIS tools to allow automatic learning of the inverse kinematics.

2) Use a Forward Kinematics model to generate training and validation data to test the ANFIS sytem's ability to generalise.

3) Test your ANFIS Inverse Kinematics tool for selected positions in 3D space to obtain Joint Coordinates.
4) Compare (numerically) the results obtained using the ANFIS system with the analytical Inverse Kinematics model.

TO ATTAIN A HIGHER MARK CARRY OUT ONE OR MORE OF THE FOLLOWING:

1) Either analytically, experimentally or both, compare the approaches above with ANN methods for deriving the inverse kinematics of this robot.
2) Investigate the problems of operating the robot close to a singularity in its workspace. What methods and algorithms could you use to avoid the problems of operating in this domain?
3) Consider ways in which a search algorithm (e.g. an Evolutionary Algorithm) could be used to find optimal parameters for the ANFIS and/or ANN implementations. If time permits, implement such a system using MATLAB.

Reporting

You have to write a report, using not more than 2000 words to describe your investigations and results. You need to:

1) Demonstrate that you understand the theory behind the approaches you use to solve a problem.
2) Include critical assessment and analysis of the relative merits of the approaches you have used
3) Show that you have an appreciation of issues and principles used to establish safe operation of manipulators in the human environment
4) Include Discussion of Results and Conclusions.
5) Provide any references using the Harvard system

http://www1.uwe.ac.uk/students/studysupport/studyskills/referencing/uweharvard.aspx

6) Provide any code you have written in an appendix. (This will not be included in the word count)

Your report will be marked based on analysis of your results, sufficient evidence and references that support your claims and clarity and relevance of your discussion.

Assessment weighting:

Discussion and Analysis of results	40%
Results obtained through calculations, coding and experiments	60%