

Question 4 Motion Control

- (a) Briefly describe the fundamental differences between the self-tuning regulator (STR) and the model reference adaptive control (MRAC). (5 marks)
- (b) Figure Q4 shows a typical servo control loop of a dc motor. The system is subject to disturbances from load variations and friction. With the aid of control block diagrams, explain how the servo loop performance can be improved by (i) a self-tuning regulator, and (ii) a modal reference adaptive controller. (10 marks)
- (c) Describe the practical difficulties of implementing real-time control on a PC platform. Suggest 3 ways of overcoming them. (10 marks)

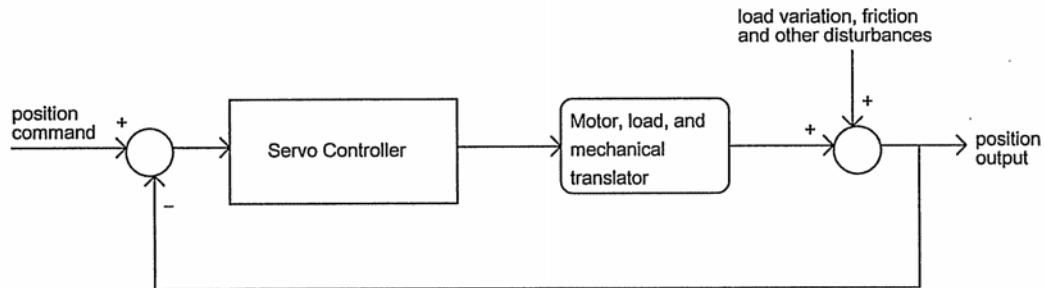


Figure Q4

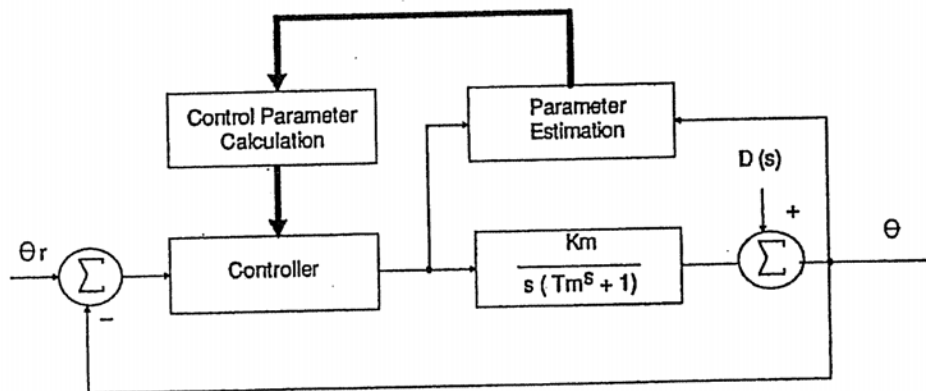
STR based on estimating the system parameters and adjusting the control settings accordingly.

MRAC involves the comparison between a reference model and the actual system (which may be the motor only or the entire position or velocity loop) and adjust the control accordingly.

Both schemes make the resulting system nonlinear, thus require careful stability analysis.

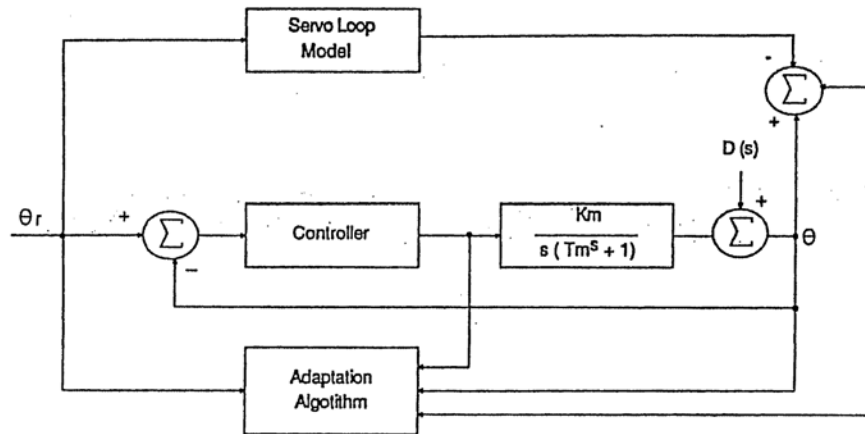
MRAC system will require a model calculation and parameter identification scheme.

(b) STR of a dc motor servo system



(add explanation)

MRAC for dc motor servo system



Add explanations

(c) Difficulties

- Windows is not a real-time platform
- The PC hardware is designed around a non real-time OS. It is difficult to use another OS to replace.

(e.g. Plug-N-play, PCI bus protocol)

Solution #1

- Use a real time OS e.g. RT-LINUX, RTI

- Disadvantage : * some PC hardware feature may no function.
* some are soft real time system only.

Solution #2

- use a stripped down version of system OS. e.g. DOS
- write your own drivers and functions from the low level.
- disadvantage : large programming effort
- advantage : low start up cost.

Solution #3

- retain the window OS
- use a separate processor card (based on DSP or RISC) to perform the real-time functions
- disadvantage : expensive hardware and software cost.
work the real-time issue on another platform