SUBJECT DESCRIPTION FORM

Subject title: Intelligent Motion Systems

Subject code: EE520

Credit value (Applicable to Postgraduate Schemes under the Credit-based System):
3

Responsible staff and department:

N.C. Cheung, Electrical Engineering

Pre-requisite:
NIL

Recommended background knowledge:

Knowledge of control engineering, power electronics, electrical machines, and computer systems equivalent to a degree in electrical engineering.

Mutual exclusions: NIL

Learning approach:

Lecture for major topics	30 hours
Presentation work, seminars and case studies	12 hours
Total	42 hours
Self-study and completion of assignments	60 hours
Case study and seminar preparation, and laboratory report	30 hours
Total	90 hours

Assessment:

Examination	60%
Test (x2)	20%
Seminar presentation	10%
Report	10%

0bjectives:

To provide an in depth knowledge of the design, operation and application of intelligent motion systems for industry and domestic purposes. Numerous application examples, which ranges from CD players and hard disc drives to robots and component insertion machines, will also be covered.

Keyword syllabus:

Structures of Intelligent Motion Systems

Specifications and requirements of intelligent motion systems. Operating modes: point to point motion, trajectory path tracking, velocity path tracking, force and tension control, compliance control, vibration damping. Switching between operation modes.

Motion Actuators and Driving Techniques

Using Voice Coil Motors and DC brush motors in motion control. AC brushless motors, linear direct drive AC brushless motors and their driving techniques. Stepping motors and their limitations in motion tracking systems. Microstepping and electronic damping of stepping motors.

Motion Sensing and Estimation Techniques

Optical encoders: working principle, decoding method, and resolution enhancement through interpolation.
Syncro-resolvers: working principle and interface electronics. Velocity estimation and position estimation methods for large speed range actuators.

Motion Control Platform

Computer hardware requirements. Tightly coupled systems versus distributed systems. Application of DSPs in motion control. Communication mehtods in motion systems. Real time operating system for motion control.

Intelligent Algorithms for Motion Control and Trajectory Generation

PID controllers and their variations. Servo tuning methods. Motion control systems based on state space configuration. States observation and Kalman filters. Using Notch filters in non-rigid systems. Profile generation and motion planning algorithms.

Issues in Multi-Axis Intelligent Motion Systems

Co-ordinate mapping and dynamics transformation. Multi-axis motion planning and profile generation. Motion synchronisation between axis. Decoupling inter-axis motion interference. Applying MIMO structure in tightly coupled system.

Case Studies in Intelligent Motion Systems

Three examples will be selected from the following list:

1. Optical based position tracking in CD-ROMs and Laser discs.
2. Magnetic head positioning in hard disk drives.
3. Motion control system design in multi-axis robot manipulators.
4. Gantry robot motion systems for SMT component insertion machines.
5. Motion systems in high precision CNC tooling machines

Indicative reading list and references:

1. S. Meshkat (editor), Advanced Motion Control , PCIM reference series in Power Conversion and Intelligent Motion, 1988.
2. M.M. Gupta (editor), Intelligent Control Systems: Concepts and Applications , IEEE Press, 1996, ISBN 0-7803-1063-2.
3. K. Rajashekara (editor), Sensorless Control of AC Motors , IEEE Press, 1996, ISBN 0-7803-1046-2.
4. P.H. Garrett, Advanced Instrumentation and Computer I/O Design: Real Time Systems Computer Interface Engineering , Prentice Hall, 1994, ISBN 0-7803-1060-8.
5. Y. Oshima, Y. Akiyama (editors), Servo Sensors Elements and Applications , PCIM reference series in Power Conversion and Intelligent Motion, 1988.
6. W.S. Levine (editor), The Control Handbook , CRC Press, 1996, ISBN 0-8493-8570-9.

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