

- industry cross-fertilisation
- technology transfer
- industry forum
- seminars
- consultancy and case studies
- training

Intelligent Control and Machine Learning for Control and Signal (One-day Course)

Agenda

Artificial intelligence and machine learning has received a new impetus in recent years and offers new opportunities and potential products. This one-day course is concerned with the different methods, which form the family of AI techniques that are particularly relevant to control engineering applications. Artificial intelligence can be utilised in control applications in two ways. The first involves the use of big data that enables the experience gained to inform control actions or initiatives. The second is more focused on the use of AI to provide improvements for control systems or signal processing at a local plant level. There is a large technical divide both in notation and understanding between the AI software communities and the industrial control based engineers. The course will help bridge this divide by establishing the links and exploring the opportunities.

The focus is on the application of machine learning or AI based modelling and identification to industrial control problems. The influence of AI methods on system modelling and system identification provides a different philosophical approach to aspects of control design. The AI methods cover areas such as neural networks, fuzzy logic and control, and they utilise optimisation algorithms such as genetic algorithms. The different topics will be overviewed and the new perspective AI and machine learning provides will be reviewed. A simple approach to including AI features in model based nonlinear and predictive control algorithms will be described.

The course is intended as an introduction to the subject and the PowerPoint notes will therefore be provided in a tutorial manner. The morning will be more tutorial nature and the afternoon will include topics such as a review of current research and include material that is more advanced. It is not so suitable for engineers already using AI methods, although it will provide insights into the role they can play in advanced control applications.

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09.00 Welcome and Introduction to the Course

09.10 Introduction to Intelligent Control and Machine Learning I

(Introduction to Artificial Intelligence, Motivation and Terminology, Machine Learning, Reinforcement Learning, Big Data and Deep Learning, Importance of artificial Intelligence in control applications).

10.00 TEA/COFFEE

10.15 Introduction to Intelligent Control and Machine Learning II

(Historical perspective, main ideas and techniques, machine learning, developments in AI, multi-agent systems, possible application areas, benefits in control applications).

11.15 Neural Networks

(Introduction to Neural Networks and exploitation in AI based systems, use in condition monitoring and fault detection)

12.00 LUNCH

13.00 Relationship between Fuzzy Logic Based Algorithms and AI Methods

(Introduction to Fuzzy Control and links to AI, Neuro-fuzzy application)

13.45 Support Vector Machine Approach to System Identification

(Influence AI methods on modelling and system identification including LPV model identification for MPC)

14.45 TEA/COFFEE

15.00 Use of Optimization and Optimal Control in AI Systems (Introducing AI methods into (Nonlinear and also Predictive Controls, Use of Genetic Algorithms, Why AI is important in applications, Use in industrial applications)

15.45 Review of state of the Art of Developments in AI for Control Applications

(Overview of recent published results in AI/ML for industrial systems control, and applications in pharmaceuticals, chemicals, petrochemicals, water)

16.30 Software Demonstration of the Use of AI in Applications

(AI based LPV model identification of Continuous stirred-tank reactor and Diesel/SI engine)

17.00 CLOSE