Modelling Simulation and Machine Learning

Hani Hagras
Fuzzy Systems for Modelling and reasoning

Edward Tsang
Computational finance
Constraint satisfaction
Machine Learning

Qingfu Zhang
Mathematical modelling
Optimisation
Machine Learning

Research Agenda in Modelling

- Modelling involves
  - Identifying stake holders, and
  - Describing their relations
- Relations are described
  - Mathematically, or
  - Procedurally
- Modelling give us a chance to find equilibrium of the system

Research Agenda in Simulation

- Given a model, equilibrium can be found mathematically in simple models
- In complex models, simulation is the only practical way to find equilibrium
- Simulation may reveal conditions which lead to undesirable outcomes
  - Such are a crash in the stock market
- One may introduce policies to remove such conditions

Machine Learning in modelling

- Suppose you want to find a trading strategy
- You may build a model and simulate the performance of your strategy
- Then you may change your strategy and try again
- How many models can you test by hand?
- Machine learning does the search for you (day and night)

Sample Projects in Modelling

- Software Wind-tunnels project
  - Vernon Smith (Economics Nobel Prize laureate, 2002) wind-tunnel tested new auction designs
  - A number of projects have been developed in CCFEA
- High frequency finance project (Olsen sponsored)
  - Model trader behaviour in order to understand the market.
- Automated bargaining project
  - Approximated equilibrium through reinforcement learning
- Flexible workforce management project (BT sponsored)
  - Study different ways to allocate jobs to technicians.
- Related project: constraint satisfaction and optimization
  - Computational techniques used in some of the above projects

Why Modelling?

- Modelling has been used extensively, e.g.
  - War plans, wind-tunnels for aeroplane & car design
- A cost-effective way to assess a situation.
- Stress testing: answering "*what-if*" questions
- Machine learning enables us to *learn* policies and business strategies.
- Modelling enables us to scientifically evaluate such policies and strategies.

Remarks on Modelling

- Could we be wrong?
  - Of course we will make mistakes!
- "*All models are wrong, but some are useful*" (George Box 1987).
- But a model allows us to improve scientifically
  - Whereas "*intuition*" goes when people depart
- "*More calculation is better than less, Some calculation is better than none*" (translation, The Art of War by Sun Zi 6BC).

Modelling, Simulation and Machine Learning

For more information:

http://www.bracil.net/info/modelling