Temporal and Spatio-Temporal Models

Expandable Neural Models, Activity Models, Primitives, Embedded Sequences and Continuous Time Modelling.

Amos Storkey, School of Informatics.

The Big Picture

Learning is done in dynamic environments.

Need good generic modelling tools for “interesting” temporal systems.

Multivariate, high dimensional systems. Can be spatial.

Examples

- Modelling Brain Activity
- Learning to Write
- Human activity Patterns
- Tracks and Tracts in Images.
- Financial Systems
- Environmental Modelling
- Hospital Processes
- Understanding Image Sequences

Desirable Features

Utilises Temporal Causality

Efficient Modelling

Non-saturating

Multiscale

Parallelisable

Reuseable Components

Previous Work

- Large scale parallel particle filters for stochastic differential systems
  - Applied to fMRI. Looking for other apps.
- Modelling handwriting using super-positions of primitives.
- Application in Tractography:
  - Modelling and Matching Tracts embedded in 3D space using Diffusion Tensor Imaging.
- Application in Astronomy:
  - Discovery of Satellite Tracks and other linear features
- Application in Reinforcement Learning
  - Planning using EM algorithm
- Application in Image Sequences
  - Dynamic Trees

Current Work

Efficient Monte-Carlo methods for learning and Inference in continuous time systems.

Learning sequences using deep structure methods.

Discovery of object and class structure in data.

Applications in Diffusion Tensor Imaging.

People

- James Withers, Lawrence Murray, Andrew Dai, Jakub Piatkowski, Athina Spiliopoulou, Bessi Bjarnason.

Overall Goal

Temporal Systems Model that:

- Allows efficient representations
- Provides greedy expansion procedures with sensible initialisations.
- Utilises combinations of reuseable local modelling component for global model building.
- Can be parallelised
- Provides Bayesian-consistent procedures for learning and structural design.