

# Monte Carlo Dynamic Classifier (MCDC) Tool

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- Capture specific characteristics in data sequences
- Example 1: Motion Capture  
[CMU Graphics Lab Motion Capture Database]
  - Walk
  - Dance – expressive arms, pirouette
- Example 2: [Lorenz equations](#)

# Objective

- Develop a general-purpose software to analyze spatial and temporal characteristics in data for classification and regression

# Approach

- Use state space model and Gaussian process

$$\mathbf{x}_t \in \mathbf{R}^d$$

$$\mathbf{y}_t \in \mathbf{R}^D$$

$$\mathbf{x}_t = f(\mathbf{x}_{t-1}; \phi) + \mathbf{e}_t$$

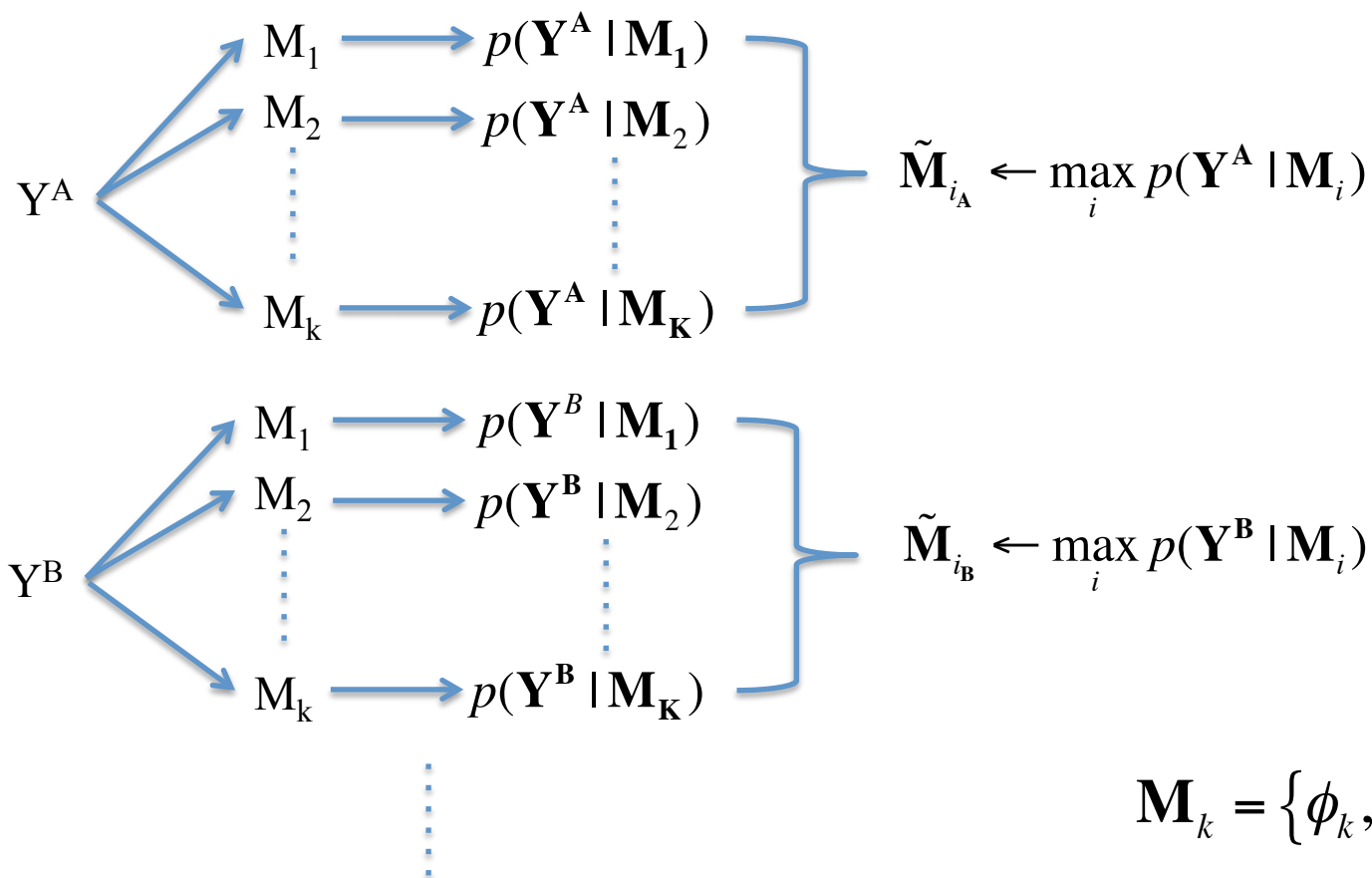
$$\mathbf{y}_t = g(\mathbf{x}_t; \varphi) + \mathbf{n}_t$$

$$f(\cdot) \sim GP(m_f(\cdot), k_{\phi_f}(\cdot, \cdot))$$

$$g(\cdot) \sim GP(m_g(\cdot), k_{\phi_g}(\cdot, \cdot))$$

# Classification strategy 1

- Estimate  $\pi(\mathbf{y}_{1:T} | \phi, \varphi)$  with
  - Monte Carlo-Sequential Monte Carlo (MC-SMC)



# Classification strategy 2

- Estimate  $\pi(\tilde{f}(\cdot), \tilde{g}(\cdot) | \mathbf{x}_{1:T}, \mathbf{y}_{1:T}, f(\cdot), g(\cdot), \phi, \varphi)$  with
  - Particle marginal Metropolis–Hastings (PMMH)  
[Andrieu, Doucet, Holenstein, 2010]

$$\mathbf{Y}^A \longrightarrow p(f(\cdot), g(\cdot) | \mathbf{Y}^A) \longrightarrow \tilde{f}_A(\cdot), \tilde{g}_A(\cdot)$$

$$\mathbf{Y}^B \longrightarrow p(f(\cdot), g(\cdot) | \mathbf{Y}^B) \longrightarrow \tilde{f}_B(\cdot), \tilde{g}_B(\cdot)$$

⋮

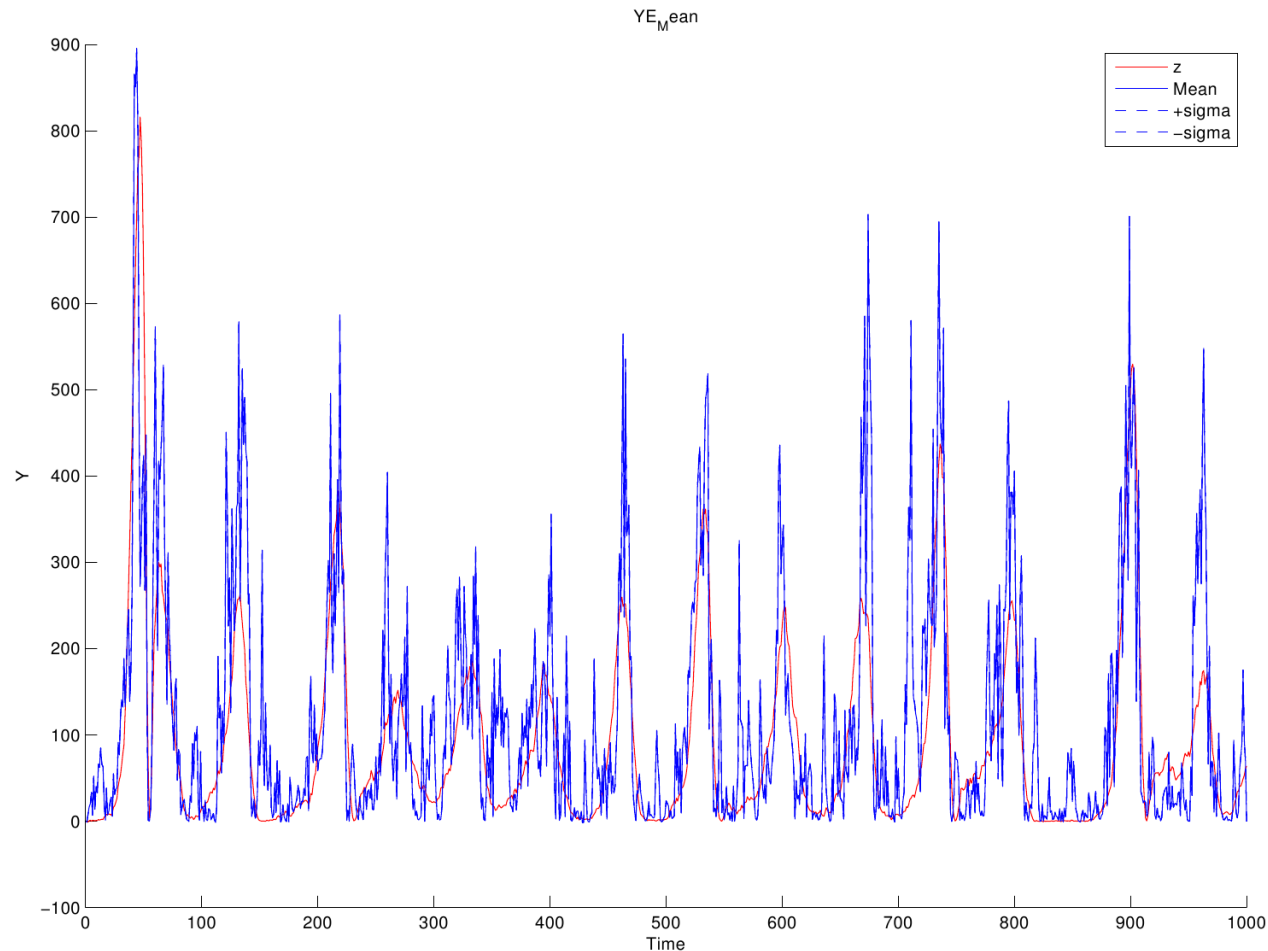
# Experiments: Lorenz

3-dim observation:

```
y1(t) = (x1(t-1) * x2(t-1) * dt) + y1(t-1) * (1 - Beta * dt) + sqrt(r1) * randn;  
y2(t) = Alpha0 * x1(t-1) .^ 2 + sqrt(r2) * randn;  
y3(t) = Alpha0 * x2(t-1) .^ 2 + sqrt(r3) * randn;
```

2-dim state

```
x1(t) = (  
x2(t) = (  
andn;  
andn;
```



# Future Plan

- Open MCDC tool next (early) year.

MCDC

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Document

Examples ▾

↔ Japanese

## Monte Carlo Dynamic Classifier

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### Introduction

This manual is to explain the program execution procedures created in the Monte Carlo Dynamic Classifier (MCDC) Tools development and experiment supporting work. Monte Carlo Dynamic Classifier Tools is a program that performs model estimation of arbitrary observed data sequences and estimation of state sequences of its estimated model. The estimated model can be used for class separation of observed data sequences by applying it to different observed data sequences and calculating the likelihood of the model. MCDC Tools is composed of the following program bundle:

MCDCTrain

Model estimation program

MCDCTest

Calculation of model likelihood program

Graphs

A set of functions for graph drawing of estimated models

Please refer [document](#) for the details.



Thank you!

**18:25pm at Lobby!**

Departure at 18:30pm by Bus

19:00 – 21:00pm Dinner at Restaurant

Come back to ISM around 21:30pm