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# Patterns of Adaptation: From Species to Autonomous Systems

## Why do we look at nature when looking for approaches for adaptation?

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# Why do we look at nature when looking for adaptation?

- Humans are good at adaptation because we are good at modifying our environment

- Humans are the most intelligent species in the world

- Why nature inspired approaches are more common?
  - In order to impress reviewers?
  - Unconscious idea that nature adapts better than humans?
  - Intelligence ➔ adaptation?
  - Intelligence <> adaptation?

Michael R. Bartolacci, Penn State University – Berks

# Patterns of Adaptation: From Species to Autonomous Systems

## DISASTER PLANNING AND MANAGEMENT: DO WE NEED A ROBUST TELECOMMUNICATIONS INFRASTRUCTURE THAT IS ADAPTIVE TO CHANGING CONDITIONS

# Connectivity for Disaster Management

# Natural and Manmade Disasters Create Problems for Wired and Wireless Networks

- **Damaged wireless mobile network base stations (towers and associated equipment) (e.g. – 29,000 base stations were affected by the 2011 Tohoku Earthquake and Tsunami)**
- **Damaged mobile network switching centers**
- **Damaged "landline" connectivity (coaxial and fiber optic cable networks) that interface with the wireless networks (e.g. - 1.9 million fixed-line service subscribers were affected by the 2011 Tohoku Earthquake and Tsunami)**

# Question: Is the fixed location architecture of mobile networks obsolete ?

- Can adaptive wireless technologies, such as LTE-Direct, quickly and seamlessly replace existing models of mobile network infrastructure ?
- How would users adapt to becoming sources, sinks, and intermediate nodes for mobile network traffic ?
- In the near future, will finding other users to connect through to a mobile network be as easy as finding open WiFi networks to connect to with existing mobile handsets ?

# On-the-fly paradigm for pattern learning/matching

**Ngoc Q. K. Duong**, Researcher
Technicolor R&D France.

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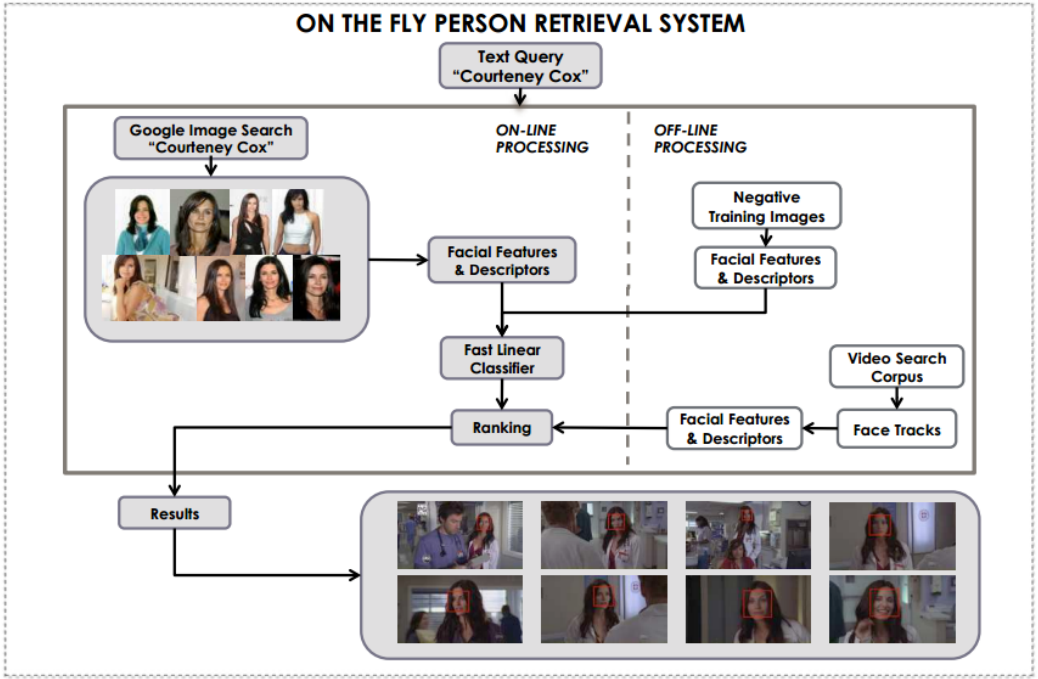
# What does «on-the-fly» mean?

- End-user can type some keywords to describe what type of pattern they want to look for, then these keywords are used as text query to retrieve corresponding examples (data) from the Internet

- Specific pattern can be extracted/learned from these retrieved examples for different purposes.

# On-the-fly in Visual Search [1,2]

- End user searching for a certain person or a visual object is only required to type person's name or object's description




[1] Parkhi et al., "On-the-fly specific person retrieval," in *13th Int. Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS)*, pp. 1–4, 2012
[2] Chatfield et al., «Visor: Towards on-the-fly large-scale object category retrieval," in *Asian Conference on Computer Vision*, pp. 432–446, Springer, 2012



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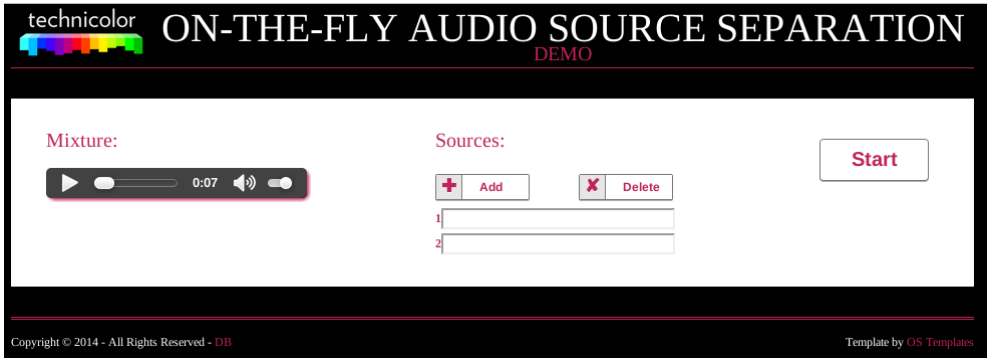
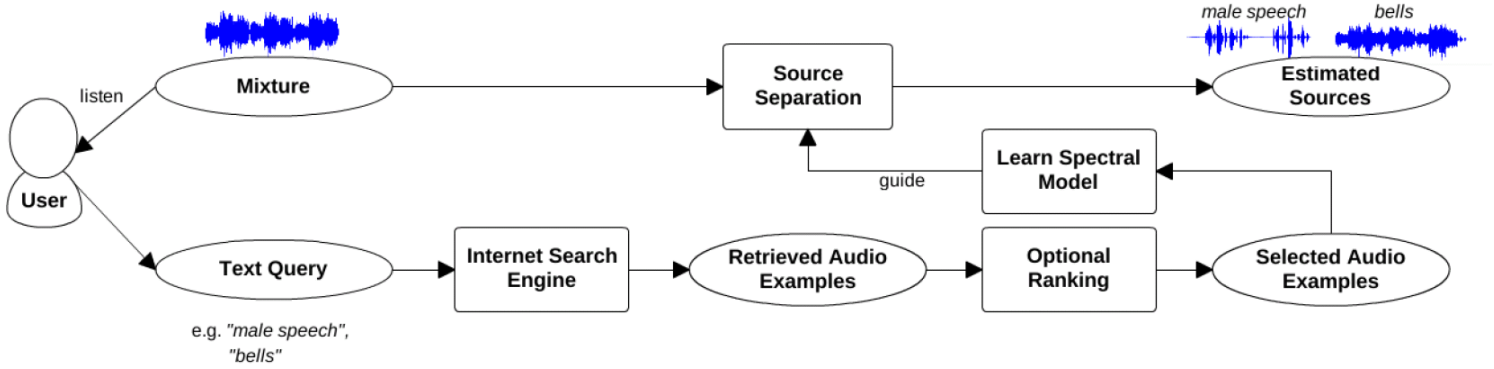
# On-the-fly in Audio Source Separation [3]




[3] Badawyd et al., "On-the-fly audio source separation," in *Int. Workshop on Machine Learning for Signal Processing (MLSP)*, pp. 1–6, 2014



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# Your discussion…?

# Patterns of Adaption: From species to Autonomous Systems

## Uncertainty
## - what & where is it and why it is important –

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# Consistent behaviour...

- Where do we have consistent behaviour?
  - Is human behaviour consistent?
  - Is nature's behaviour consistent?

**NO!**

  - Does mathematics behave consistently?

**YES! it is a universal language**

  - Does systems behave consistently?

**Yes and No!**

Åbo Akademi University

# So why is this the case with systems

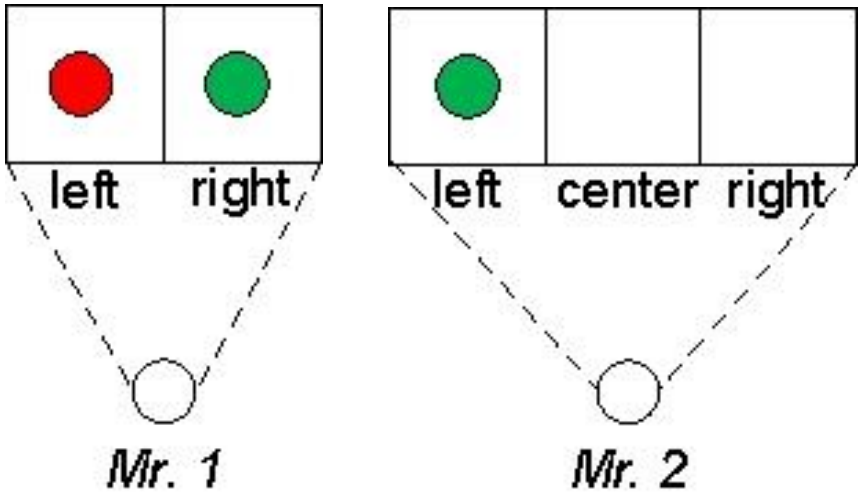
- Systems are engineered to solve a particular problem in time and space

# So why is this the case with systems

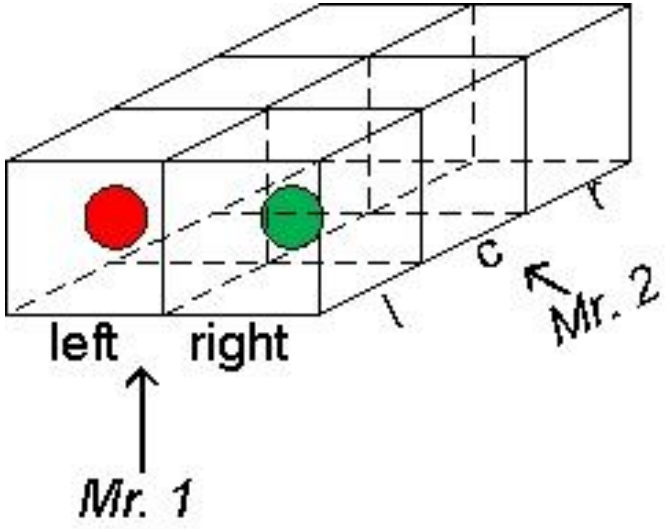
- Systems are engineered to solve a particular problem in ~~time and space~~ a **context** … by providing a response on a given input in a state
  - Systems either assumes its context
    - A confined environment
  - or is context-aware
    - Derives the current context by some means (observations) in an open environment

**So what is context-awareness?**

# Context-awareness by observations

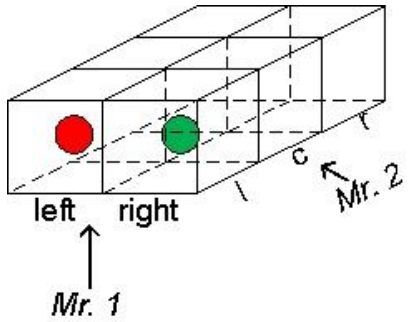


# Context-aware by observations – the context




- Requires the location + observation angle + time + **level of certainty** on the both observers

# Context-aware by observations – the context

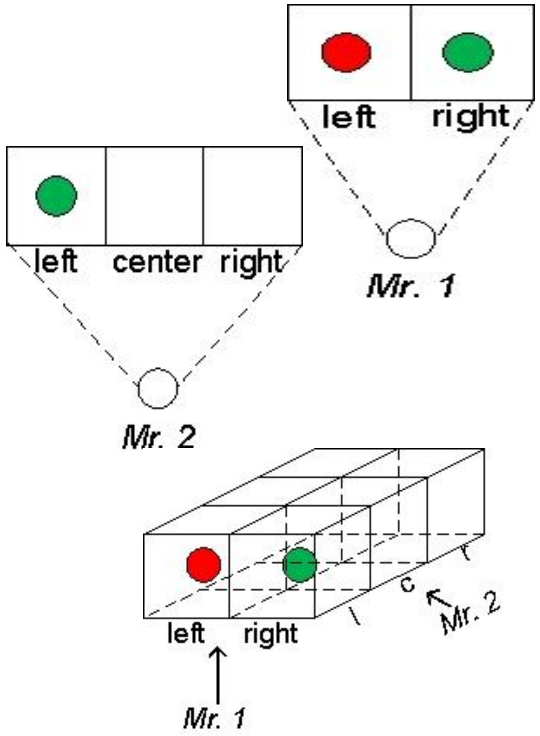



- Requires the location + observation angle + time + **level of certainty** on both observers

- Assume the colours and positions of the balls continuously changing

# Uncertainty

| Colour (one block – down right) | m | bel | pl |
|---|---|---|---|
| ∅ | 0 | 0 | 0 |
| {red} | 0,4 | 0,4 | 0,61 |
| {green} | 0,2 | 0,2 | 0,38 |
| {blue} | 0,15 | 0,15 | 0,27 |
| {red, green} | 0,13 | 0,73 | 0,85 |
| {red, blue} | 0,07 | 0,62 | 0,8 |
| {green, blue} | 0,04 | 0,39 | 0,6 |
| {red, green, blue} | 0,01 | 1 | 1 |




More "**evidence**" on observation w.r.t. down right block than down left block

# Uncertainty

| Colour (one block – down right) | m | bel | pl |
|---|---|---|---|
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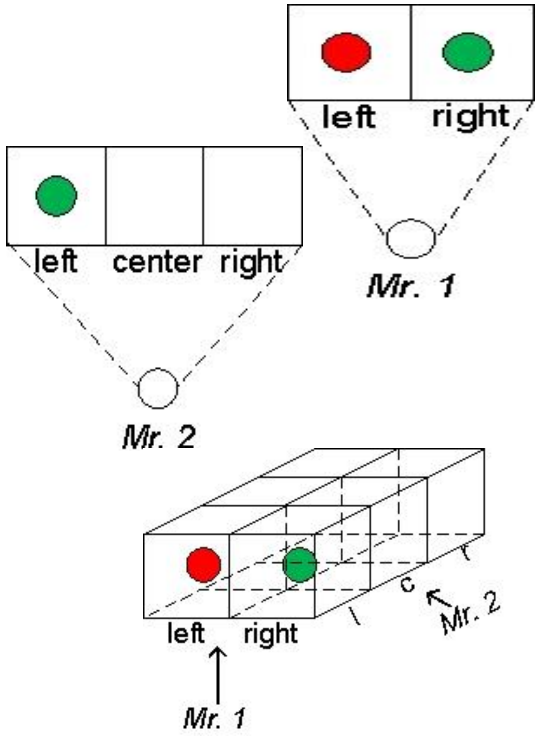


**Adaption** by changing behaviour w.r.t. evidence in favour of and (un)certainty

# Questoins - and food for thought / discussion

- Assumptions made by models often (not always) overlooks uncertainty issues
  - Though these are present whenever a thing is considered outside the domain of mathematics
- Do we need a means to measure and asses the level of uncertainty?
  - How would this be done?
  - From where do we get the parameters?