Realizing real time monitoring and controlling bio-signals

Daniel Berckmans
M3 – BIORES
Katholieke Universiteit Leuven
Belgium

Philips Eindhoven
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K.U.Leuven DIVISION M3-BIORES
Measure, Model and Manage Bioresponses

Head: Prof. Daniel Berckmans

Coordinators

Imperfectly mixed fluids

- **Ir. SEZIN EREN OZCAN**
- Dr. TADIWOS ZERIHUN DESTA
- Ir. VO TAN THANH
- Ir. NILA ALBAN
- Ir. SEBASTIAN DE BOODT
- Ing. KAREL DE BODT
- Ir. X
- Ir. X

Bioresponses 1

- **Prof. JEAN-MARIE AERTS**
- Ir. KRISTIEN VAN LOON
- Ir. GUIDO DE BRUYNE
- Ir. JORIS LEFEVER
- Ir. TOON LEROY
- Ir. JAN DEKOCK
- Ir. SARA FERRARI

Process output & environment

- **Dr. Claudia Bahr**
- Prof. ERIK VRANKEN
- Ir. OZLEM CANGAR
- Ir. SONG XIANGYU
- Ir. X
- Ir. X

Bioresponses 2

- **Dr. STIJN QUANTEN**
- Ir. PIETER SCHIEPERS
- Ir. DRAGANA MILJKOVIC
- Ir. X
- Ir. X

Secretary

- **ANN VAN GINDERACHTER**

Sound analysis and bioresponses

- **Dr. VASILEIOS EXADAKTYLOS**
- Ir. MITCHELL SILVA

Technical assistance

- **Ing. JEAN-LOUIS LEMAIRE**
- LUDO HAPPAERTS
- PRIVATE COMPANIES

BioRICS NV

- Ir. KIM BATSELIER
- Ir. FREDERIK JANSEN
- Ing. MIHAJLO MILUTINOVIC
- Ir. X
- Ir. X

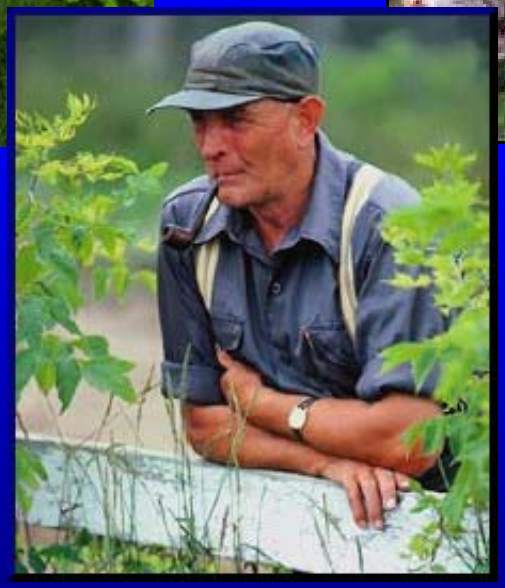
BioRICS n.v.

- K.U. Leuven, LRD (°1972): 56 spin-offs
  e.g. LMS, Ubizin, Thromb-X, ...

- 2006:

Problem

- Livestock farming in the past …



Farmer had the time to use audio-visual scoring

•Today however…

Low price of product

↳ High number of animals

↳ More welfare problems

↳ Less available time per animal

Market numbers

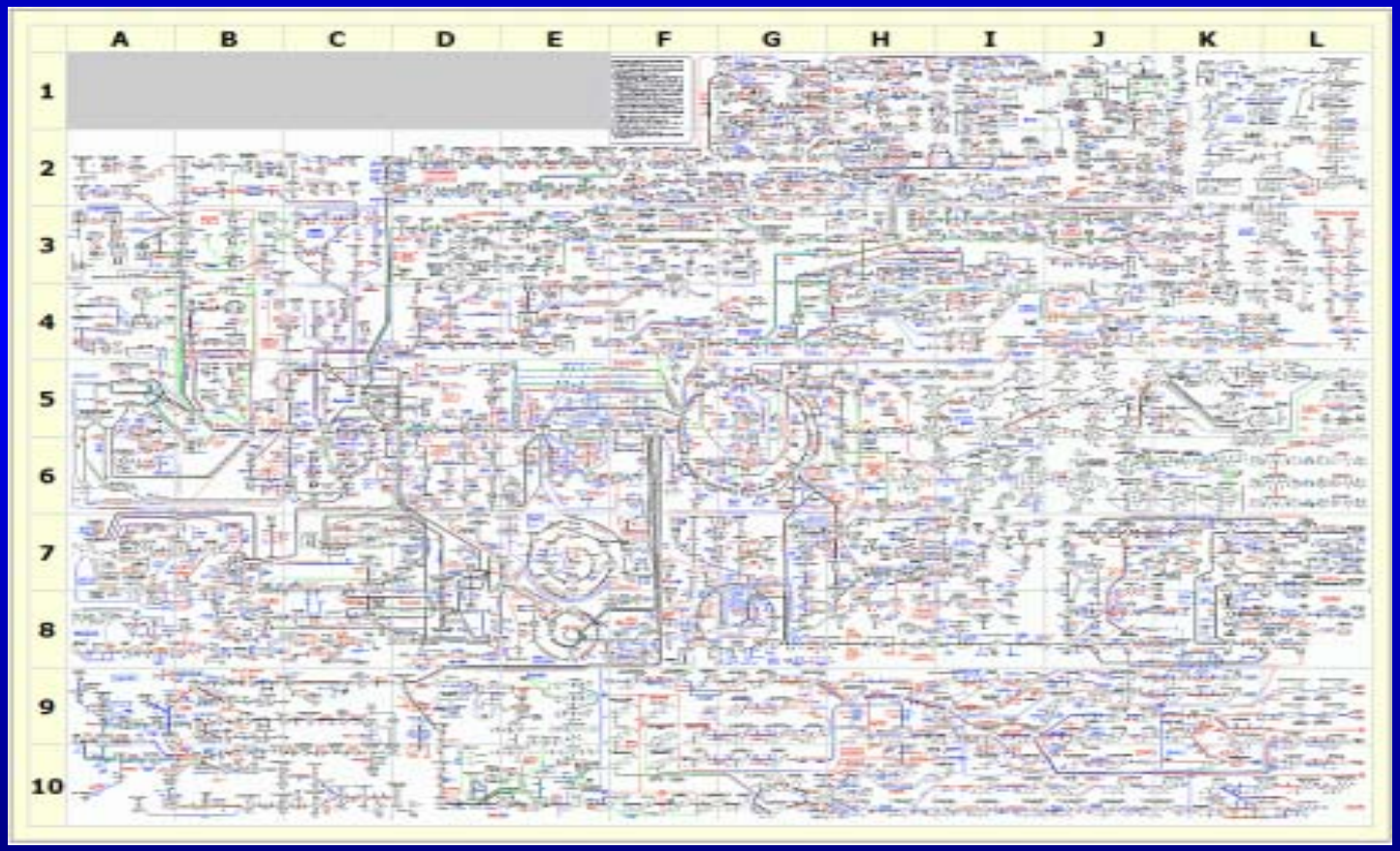
258 million ton meat/year

7 billion pigs

40 billion chicken

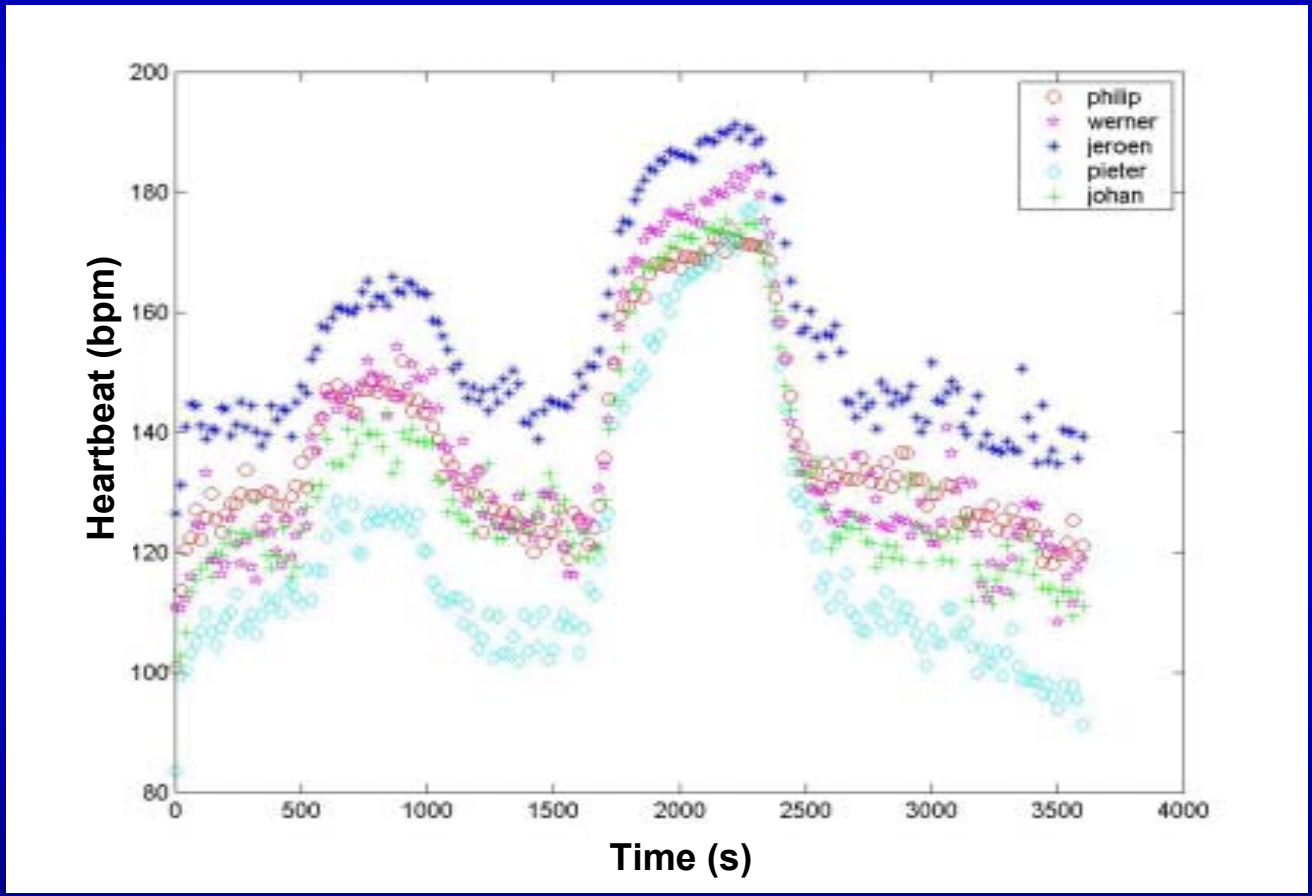
A living organism:

Complex



A living organism:

Complex **Individual**



Identical

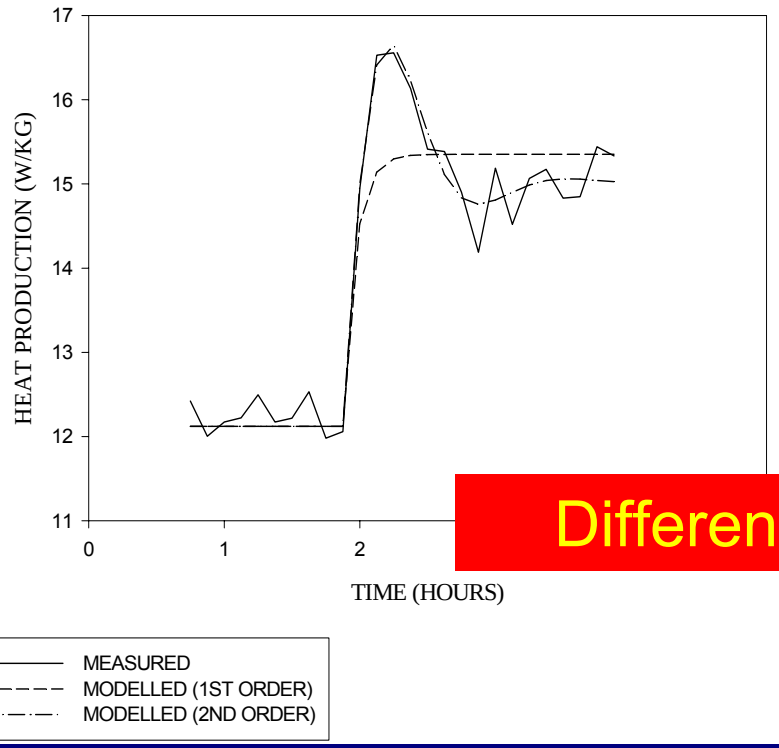
Individually different

A living organism:

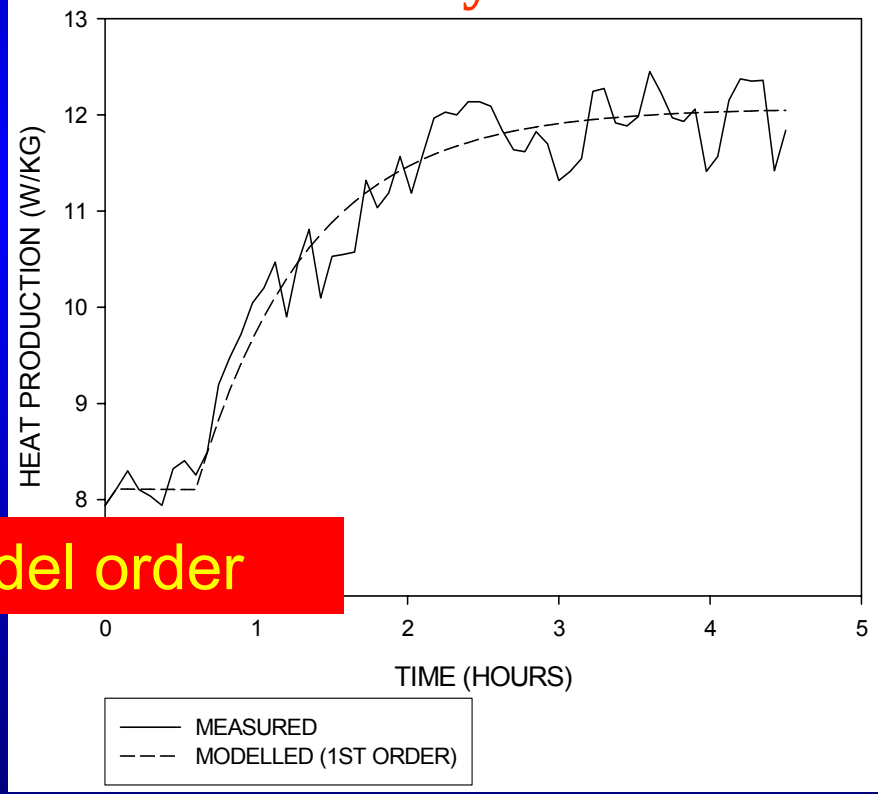
Complex **Individual** **Time-Varying**

Example: Heat production of broiler chickens

5 days old



30 days old

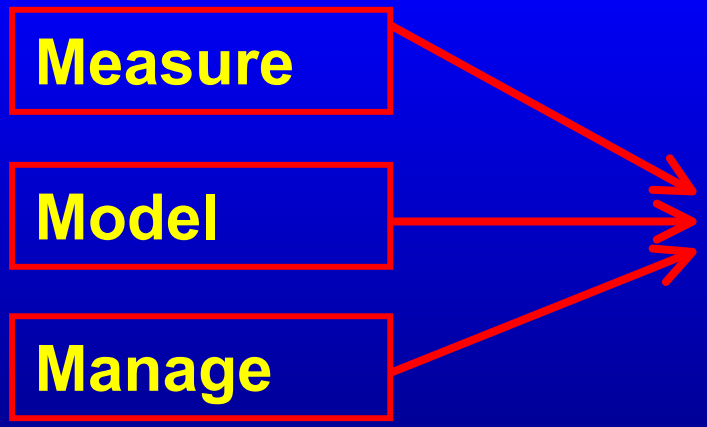


Different model order

A living organism:

Complex | **Individual** | **Time-Varying** | **Dynamic**

Living organism = CITD - system



In an on-line way

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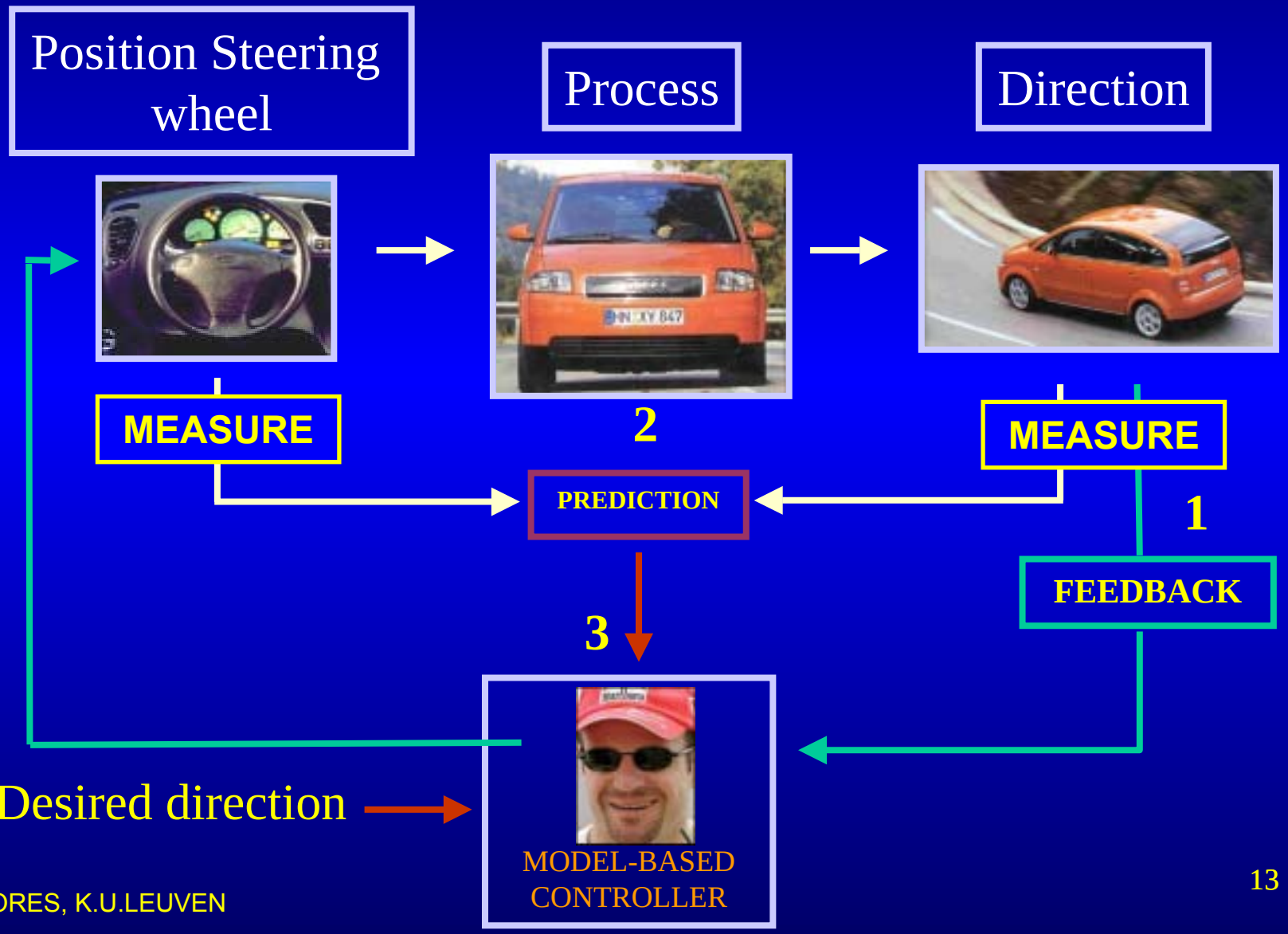
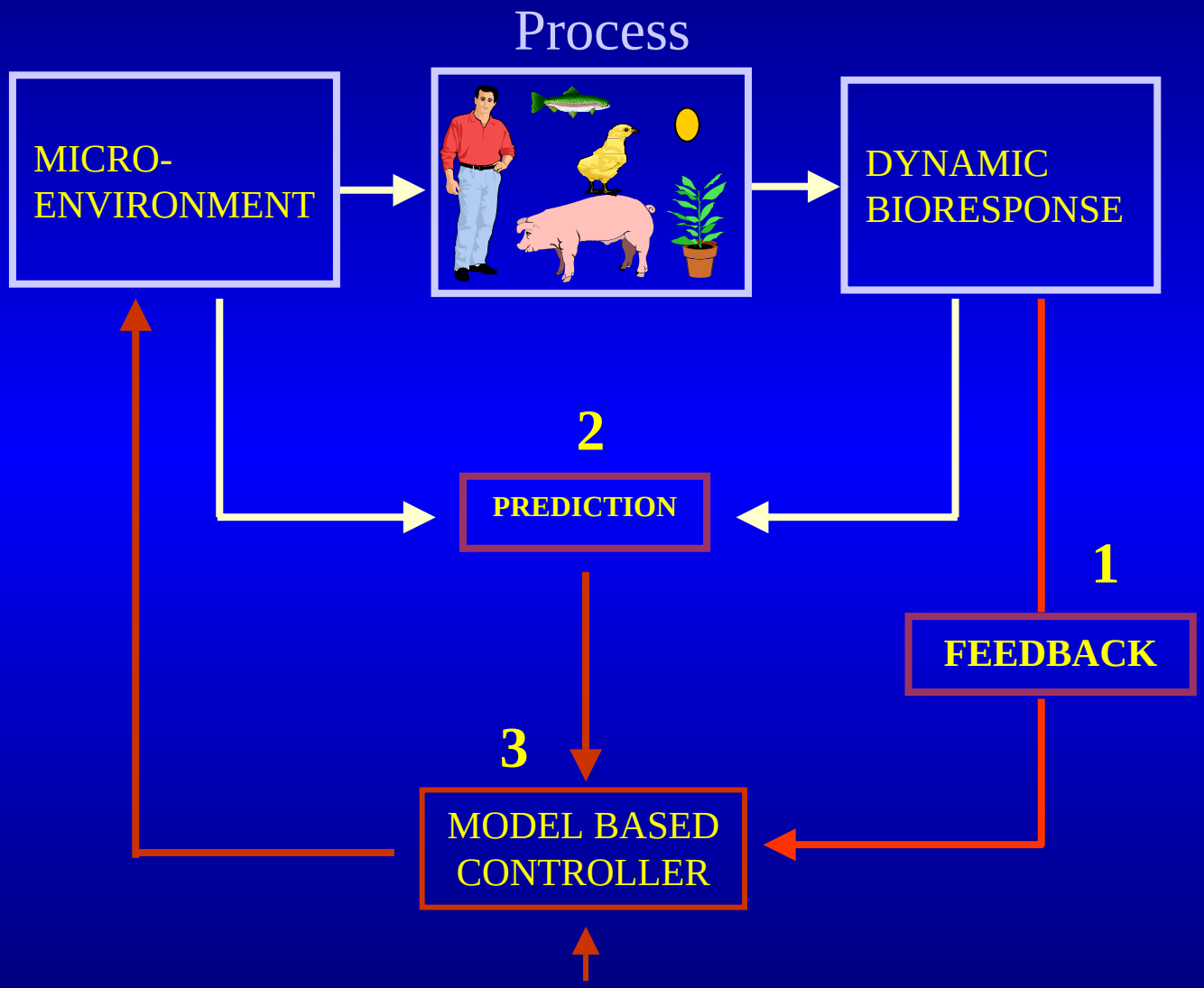
What happens today in other process control

General methodology: Conditions for process control



Control of “Biological Responses”

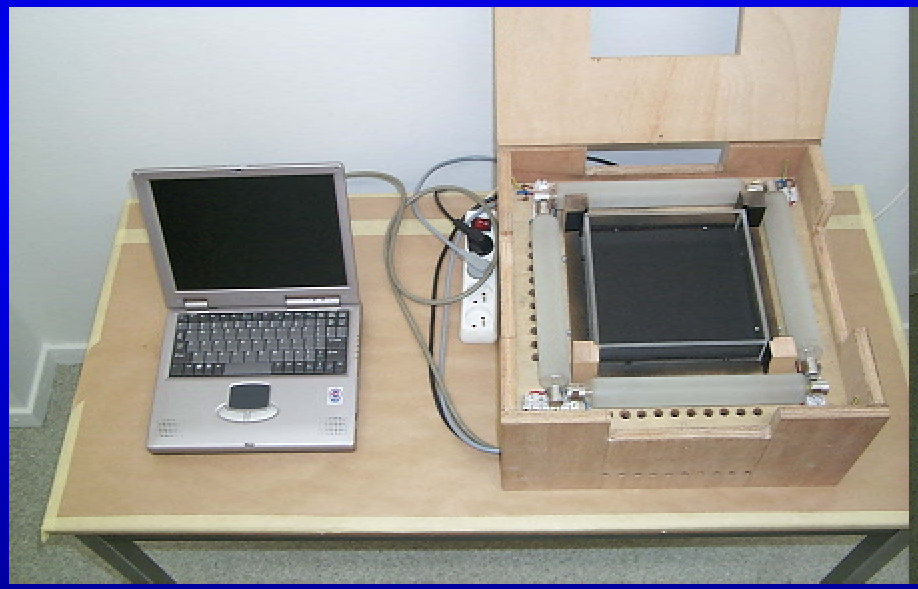


Examples

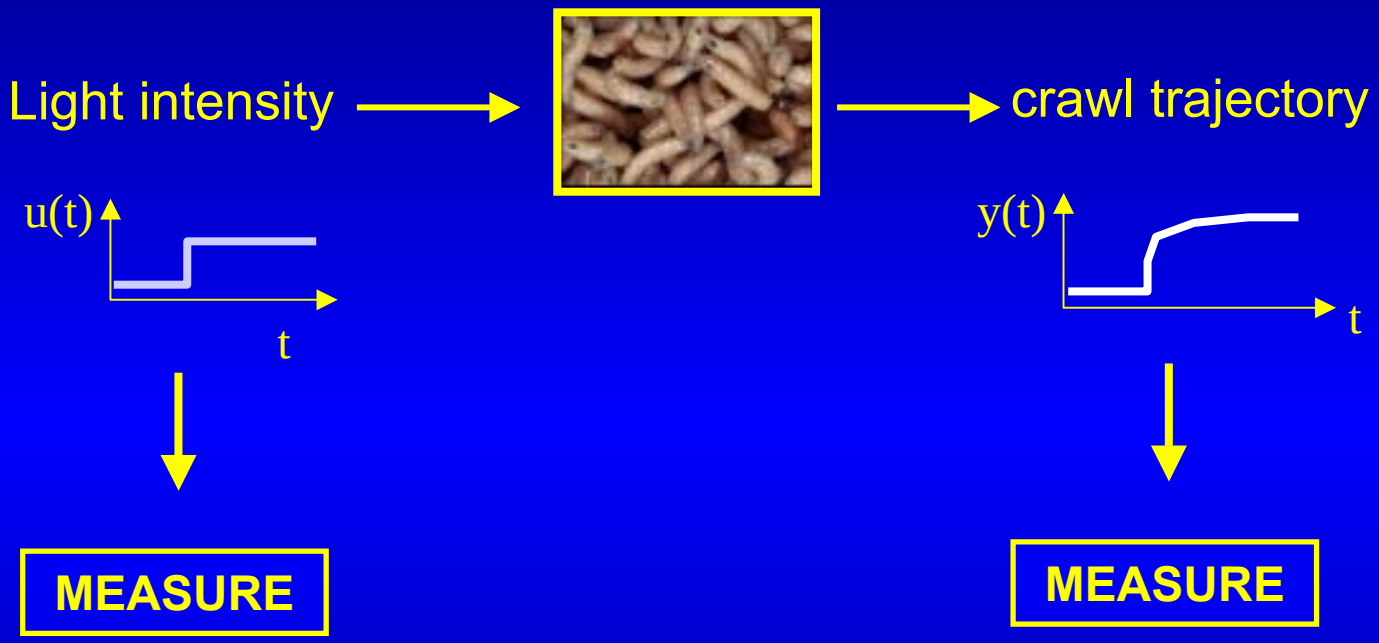
Control of the crawl trajectory of larvae of Calliphora vicina

Control of the crawl trajectory of larvae of Calliphora vicina

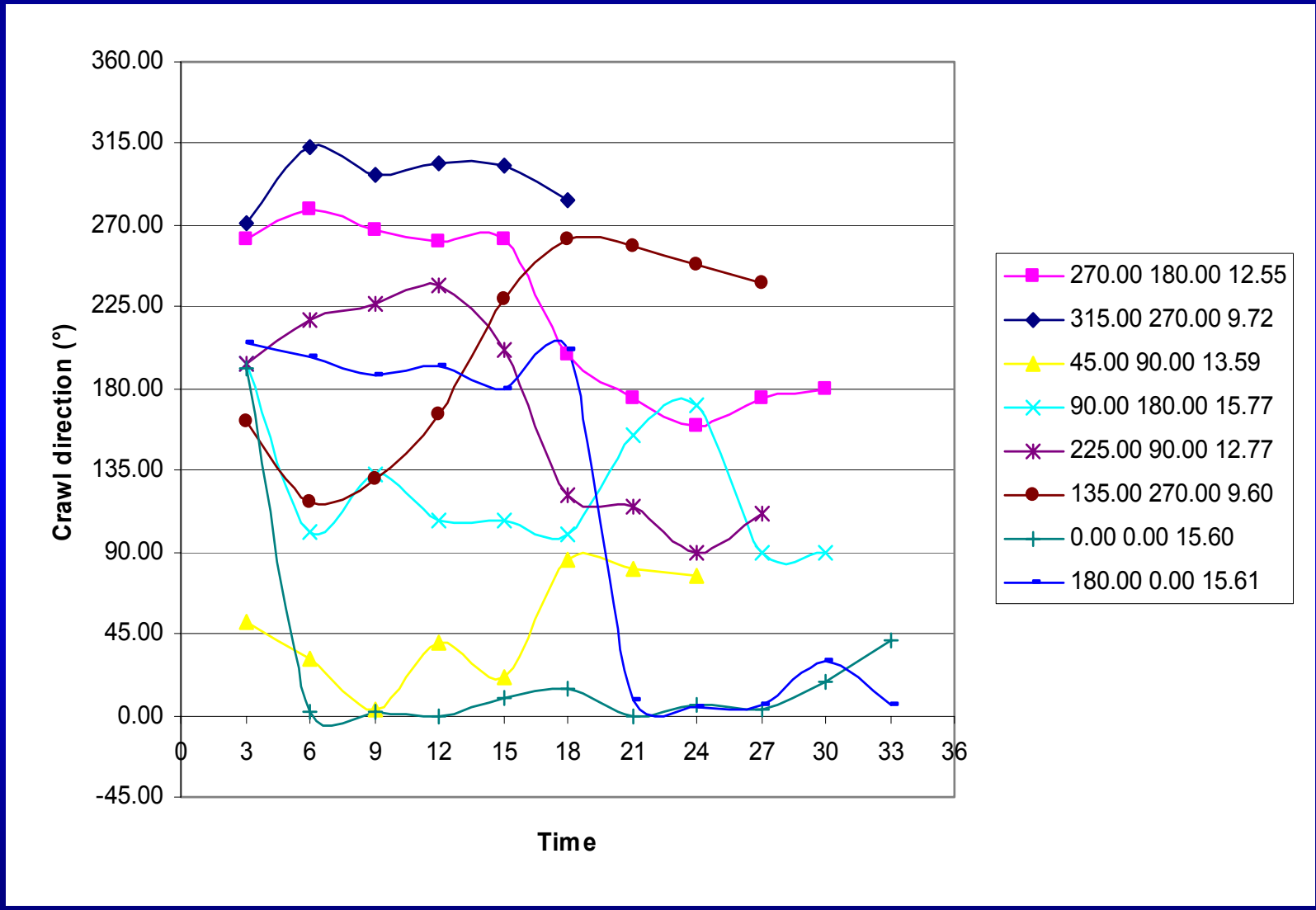
Light intensity →  → crawl trajectory



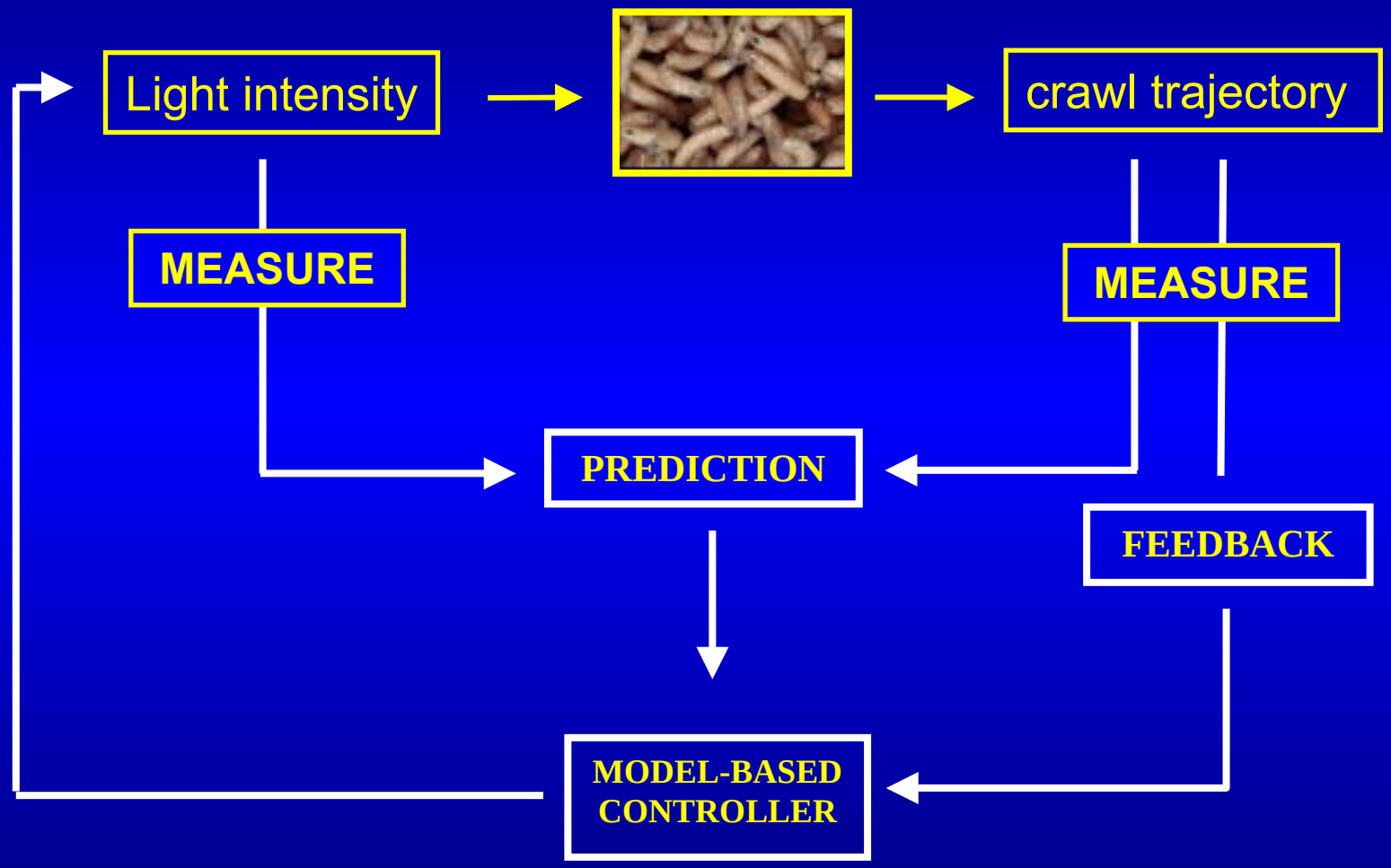
Response of crawl direction to variations in ligth



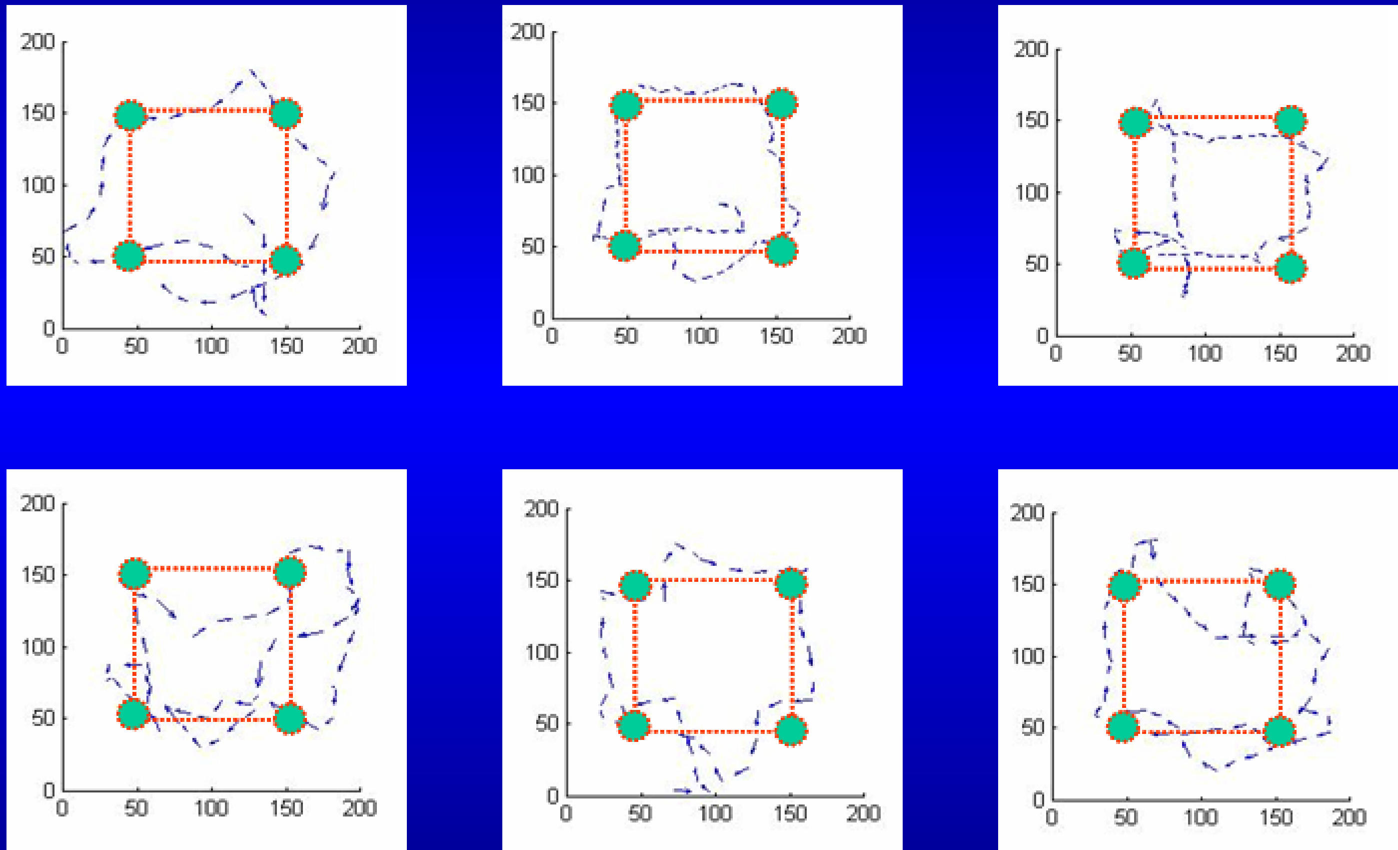
Responses of crawl direction to steps in light direction



Active control of crawl direction of larvae



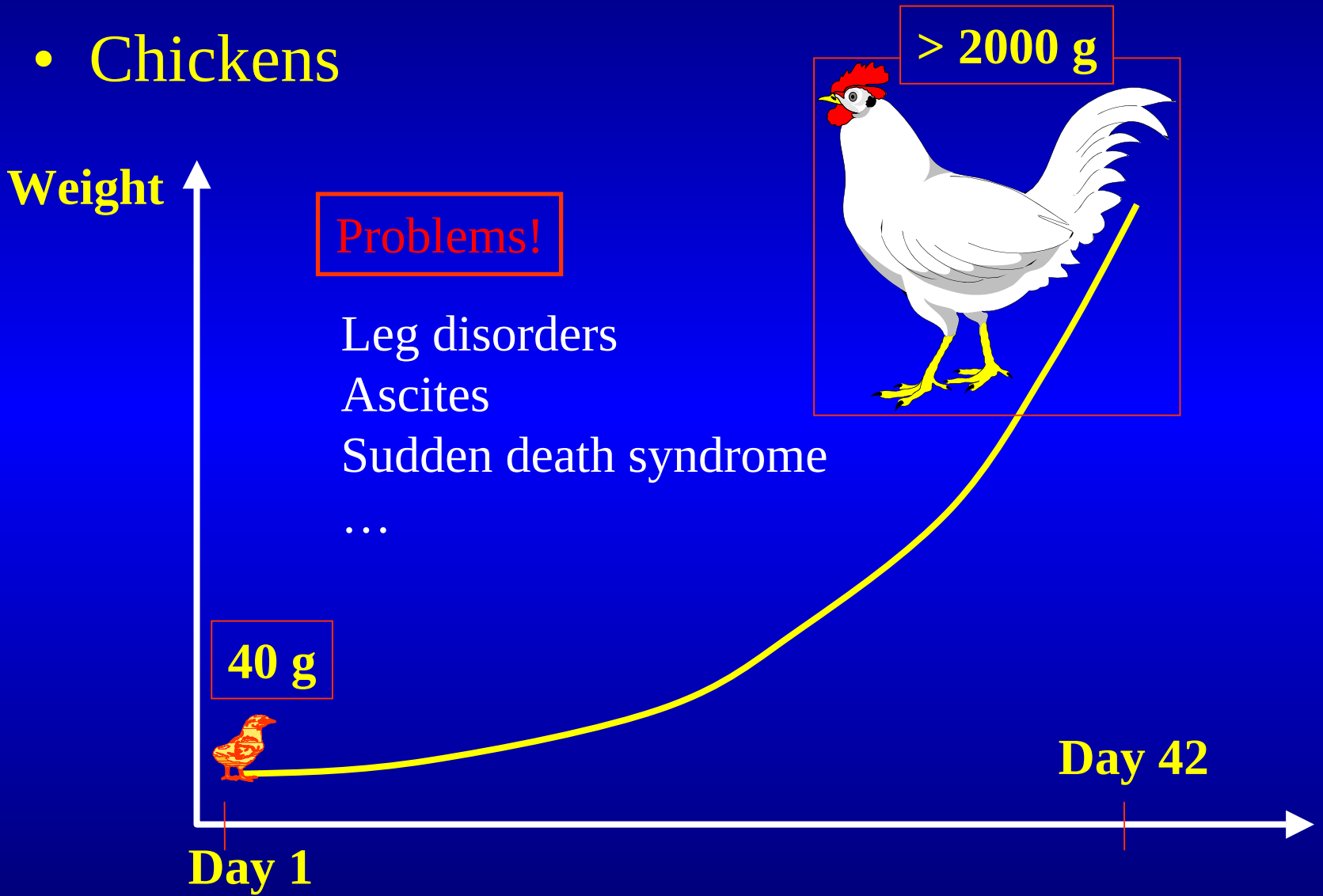
Active control of crawl direction of 6 larvae



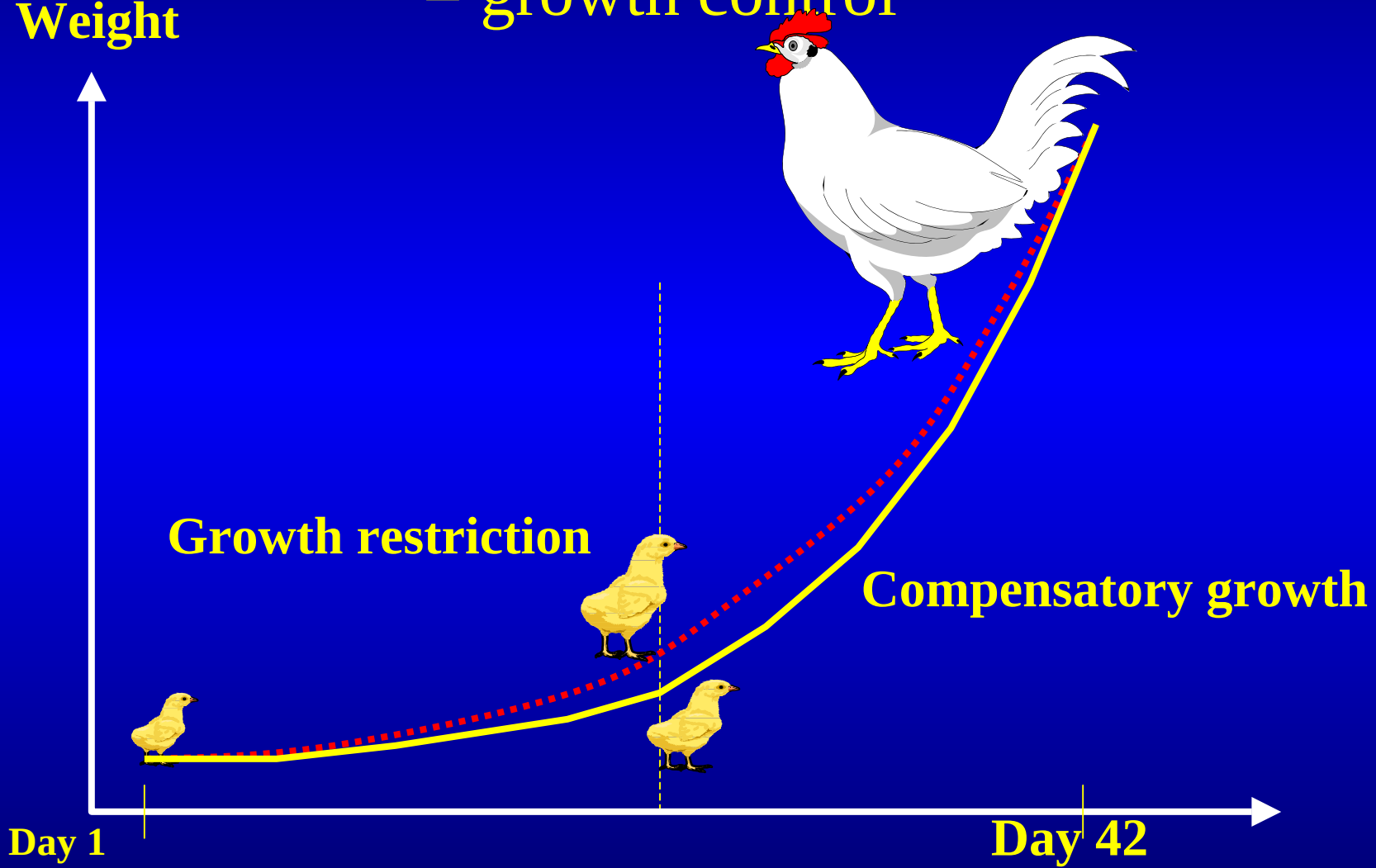
Control of the growth trajectory of chickens

Active on-line growth trajectory control

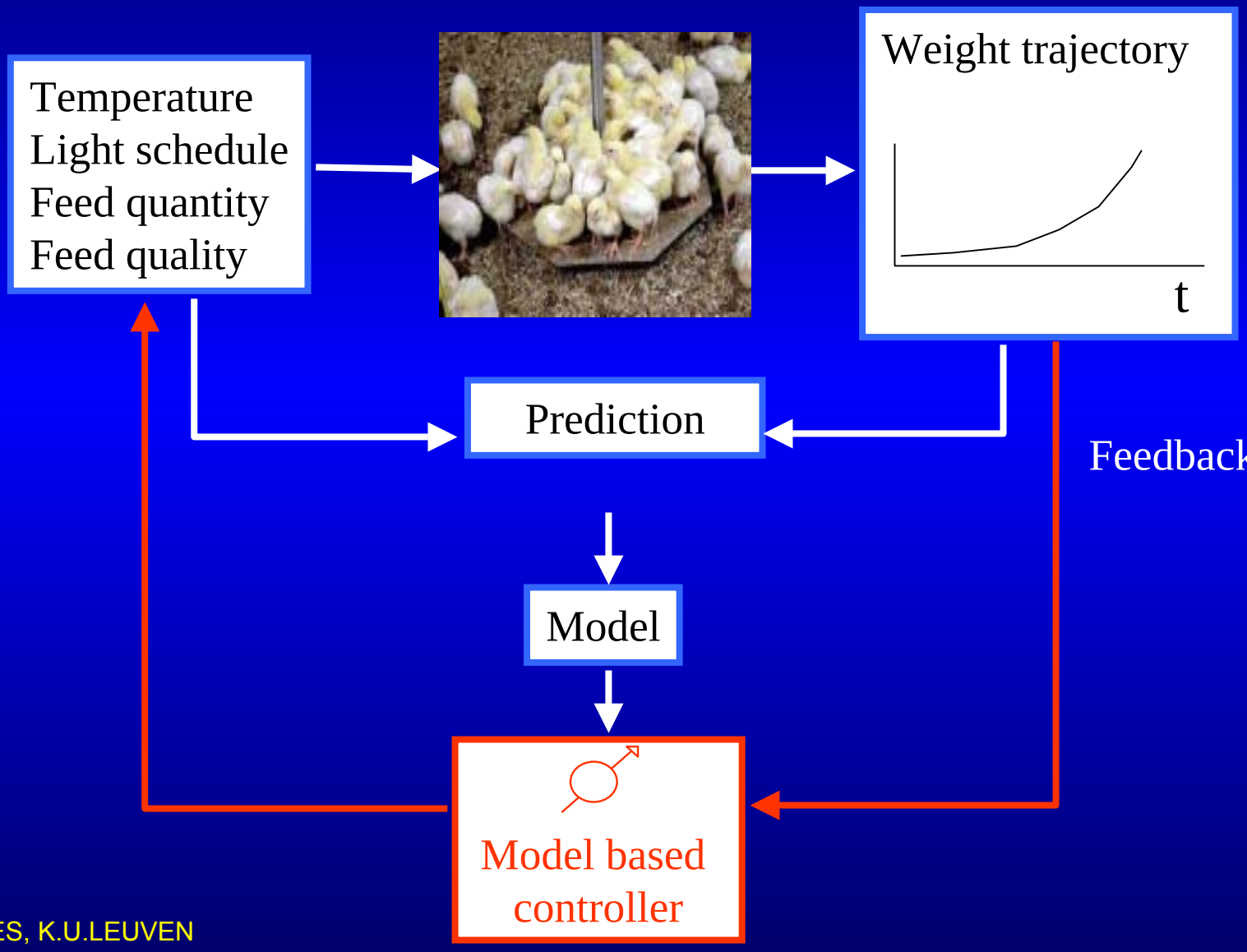
- Chickens

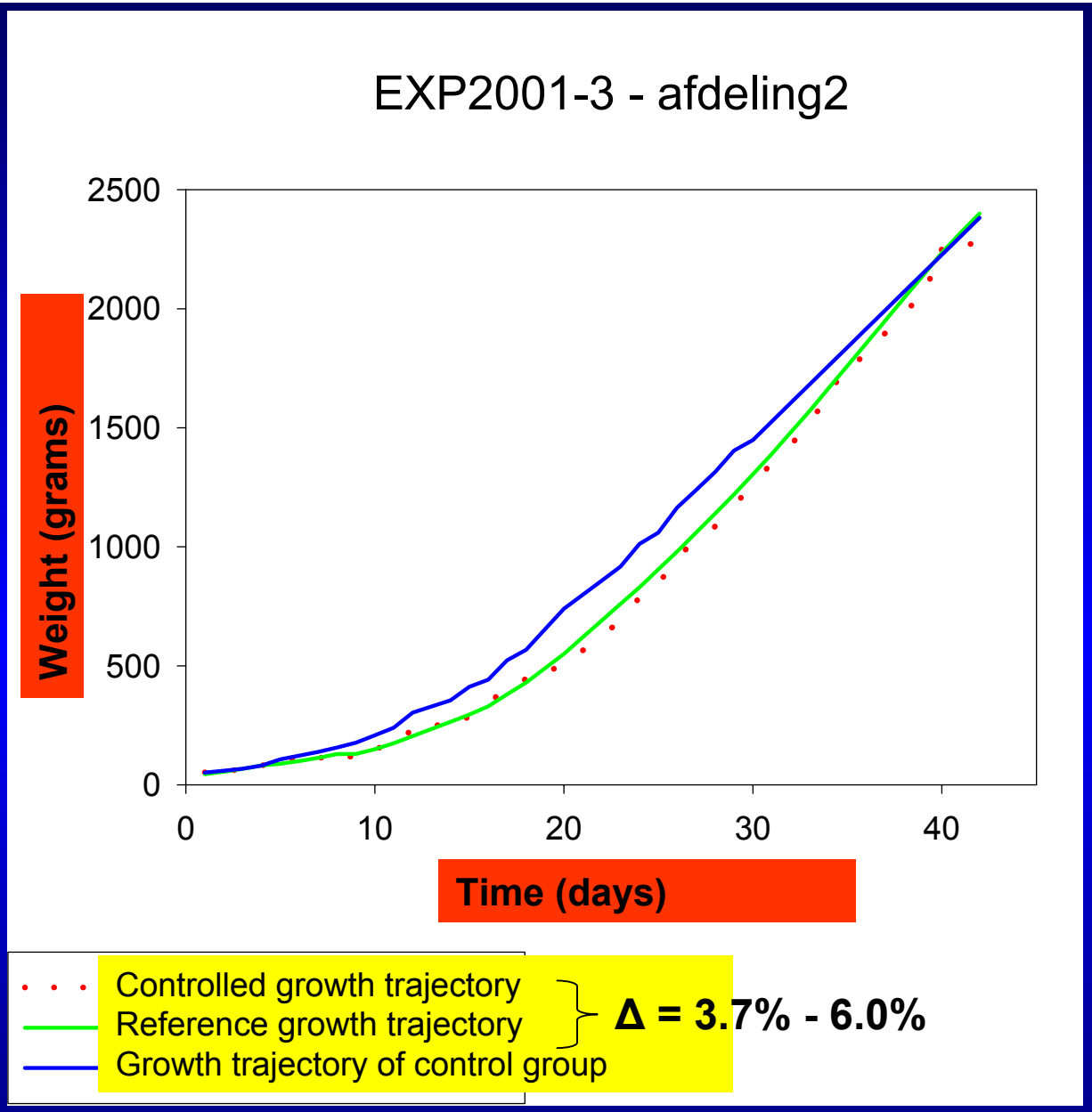


Possible solution:
Growth restriction + compensatory growth
= growth control



Control diagram





PLF control results in reduction of mortality (12 exp, 2900 animals each) of 4%

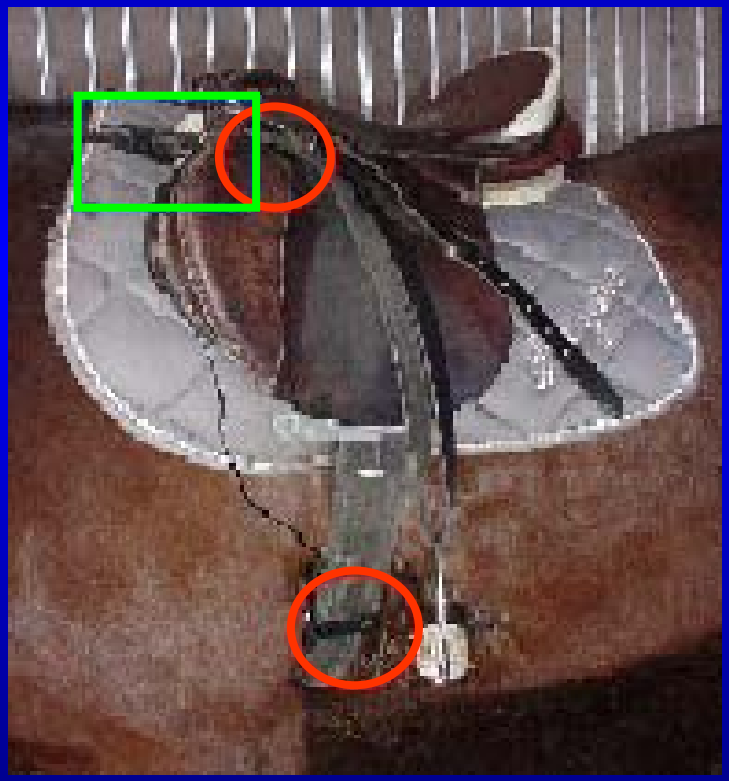
Optimisation of physical training of race horses

Optimisation of physical training of race horses

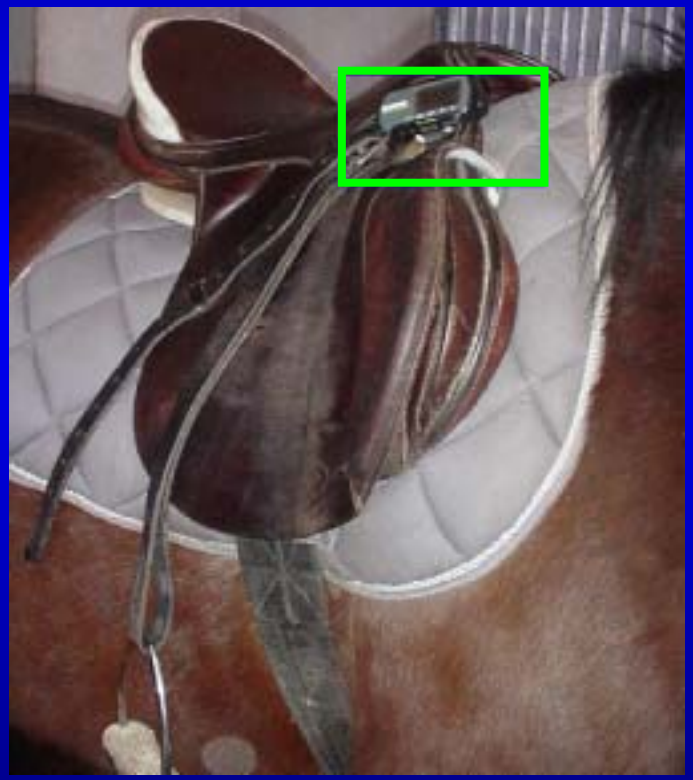
Running speed →  → Heart rate

Sensors

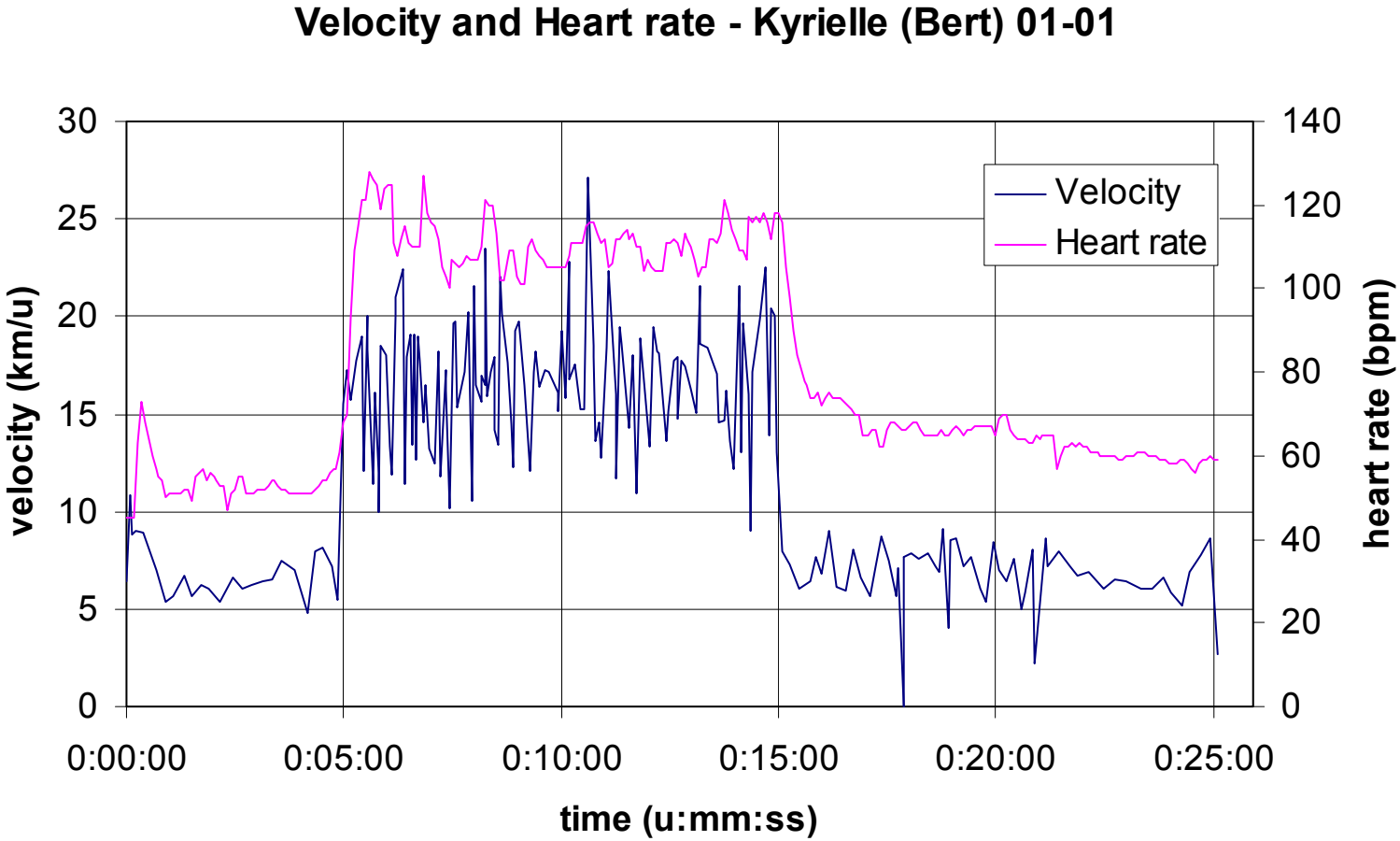
Polar equine HR monitor



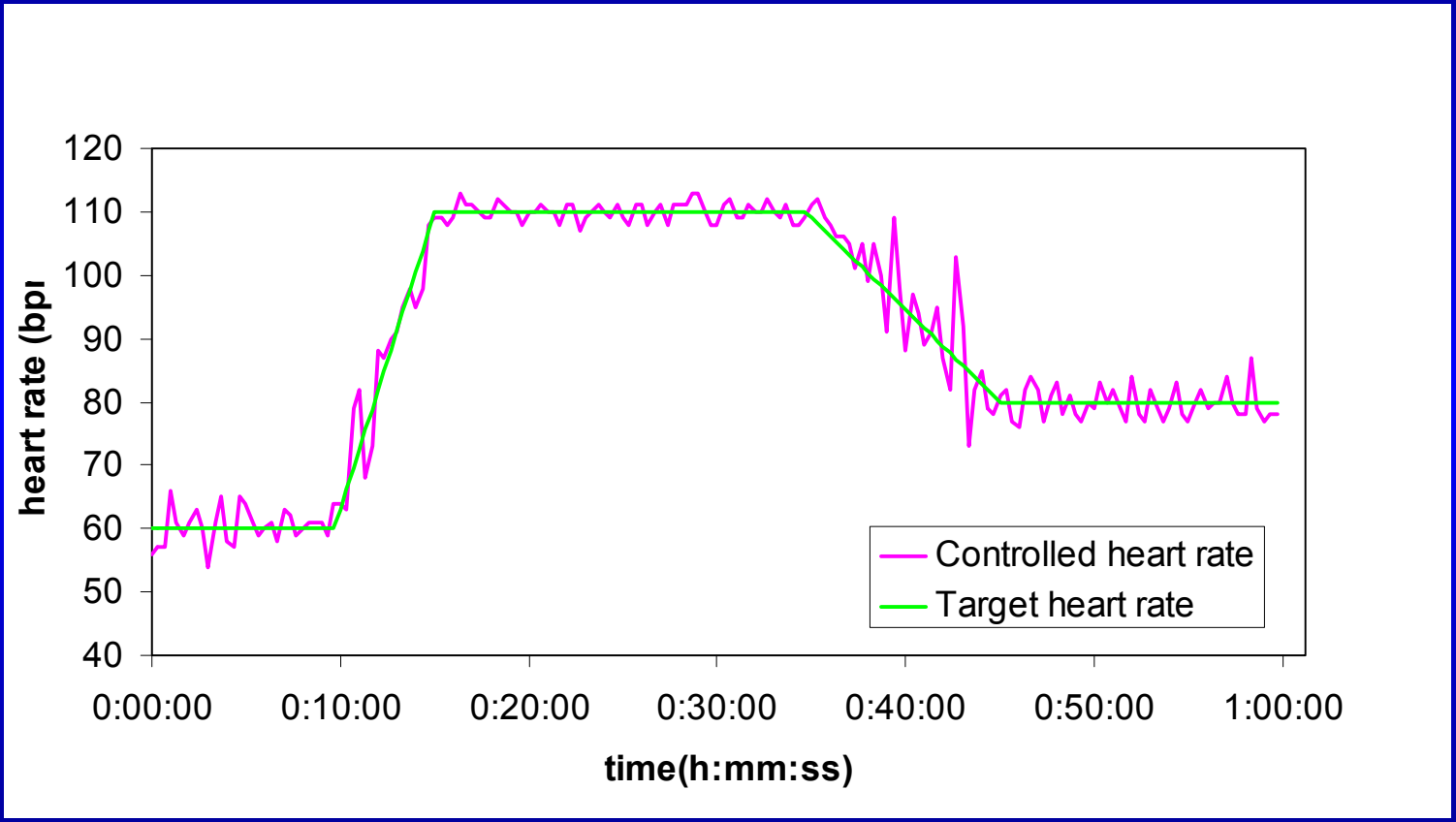
Garmin forerunner GPS



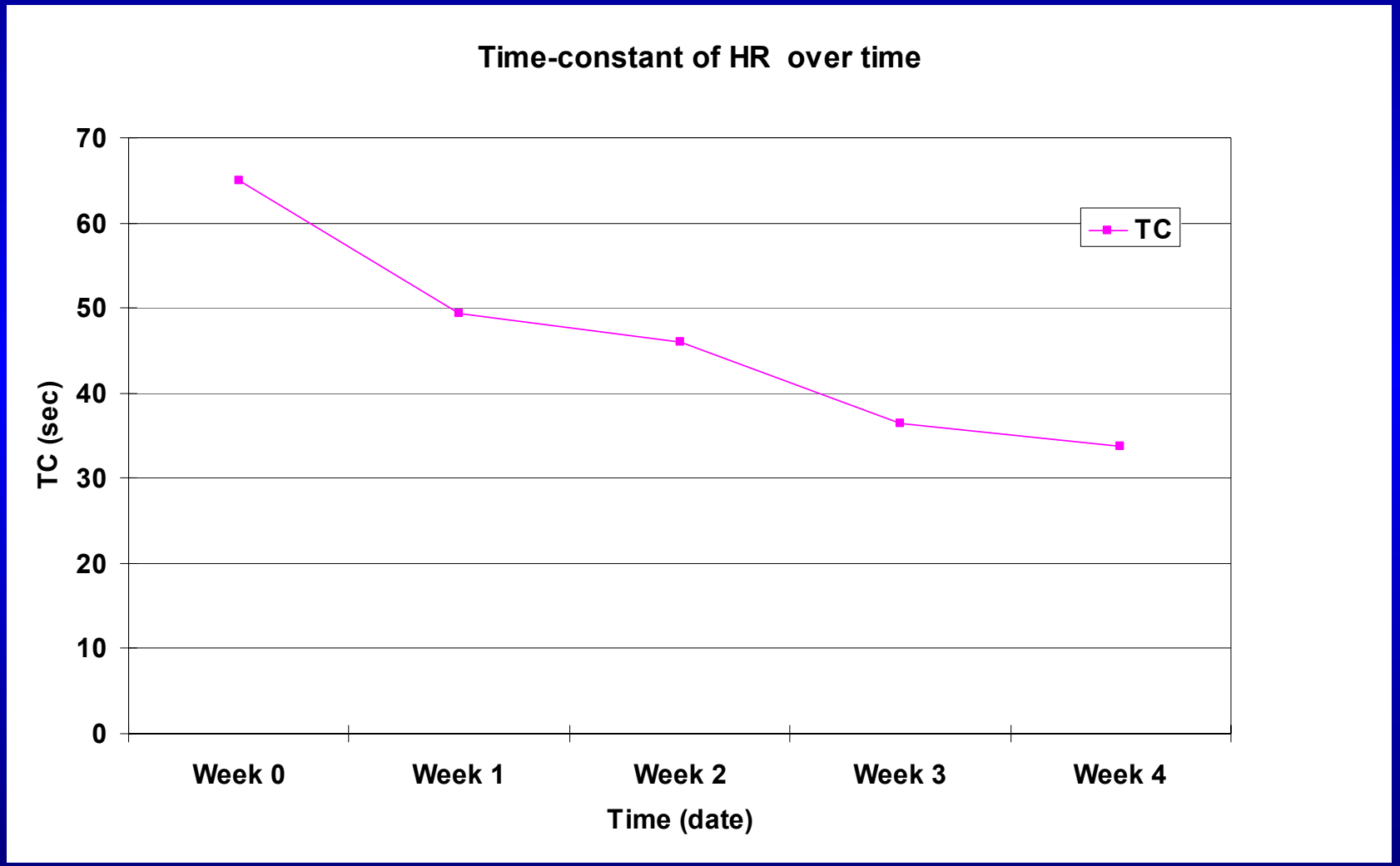
Optimisation of physical training of race horses



Optimisation of physical training of race horses



Optimisation of physical training of race horses



Model based monitoring of physical & mental performance (AC Milan)

Process

Total performance = a. Mental performance + b. Physical performance

Process

Training exercises →  → Performance

Body

↓ **MEASURE** (Inmotio)

↓ **MEASURE** (Inmotio + Hosand)

Mental monitoring

Heart Rate

Physical Activity

Mental algorithm

On-line mental monitor

Time

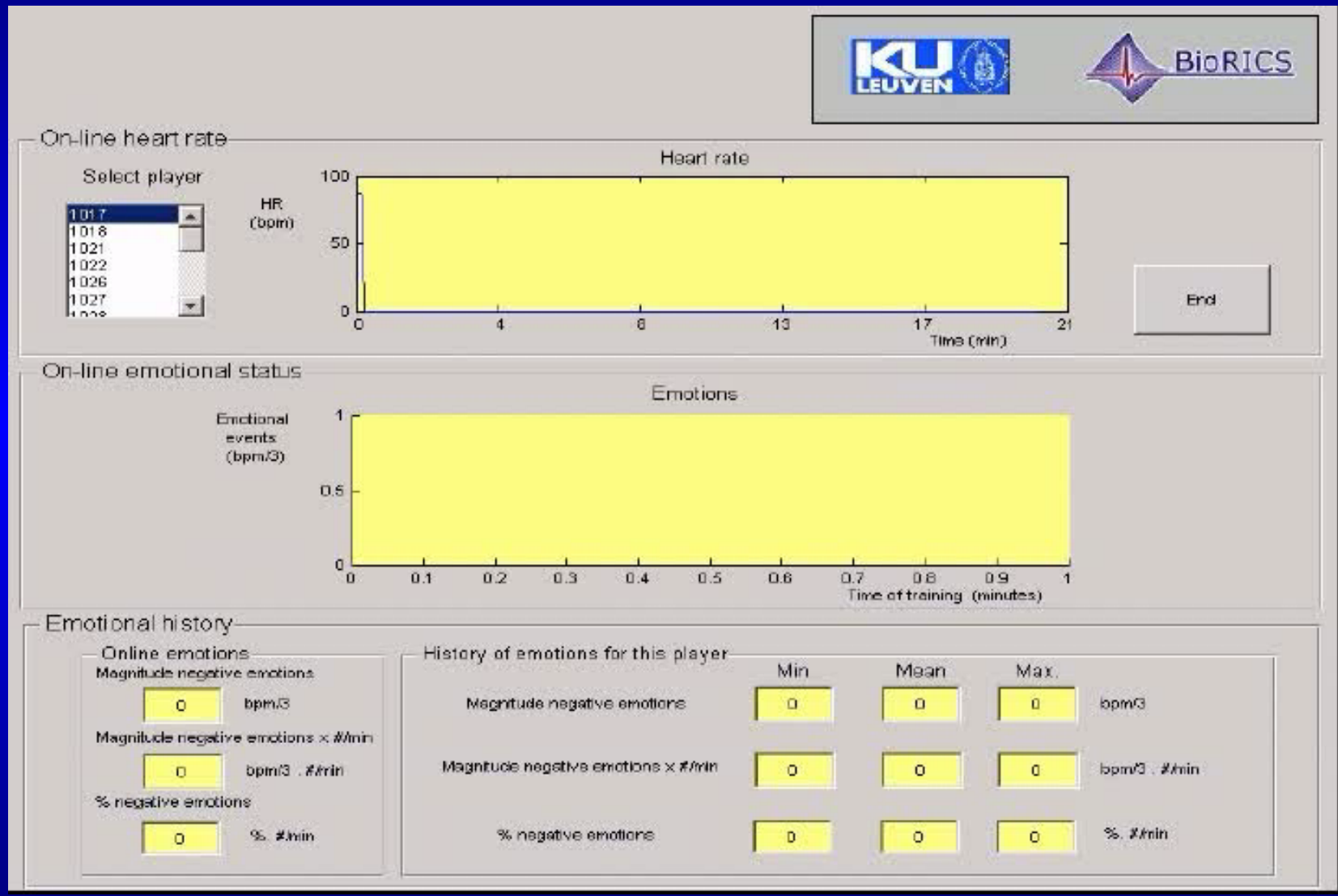
???

Reference mental status

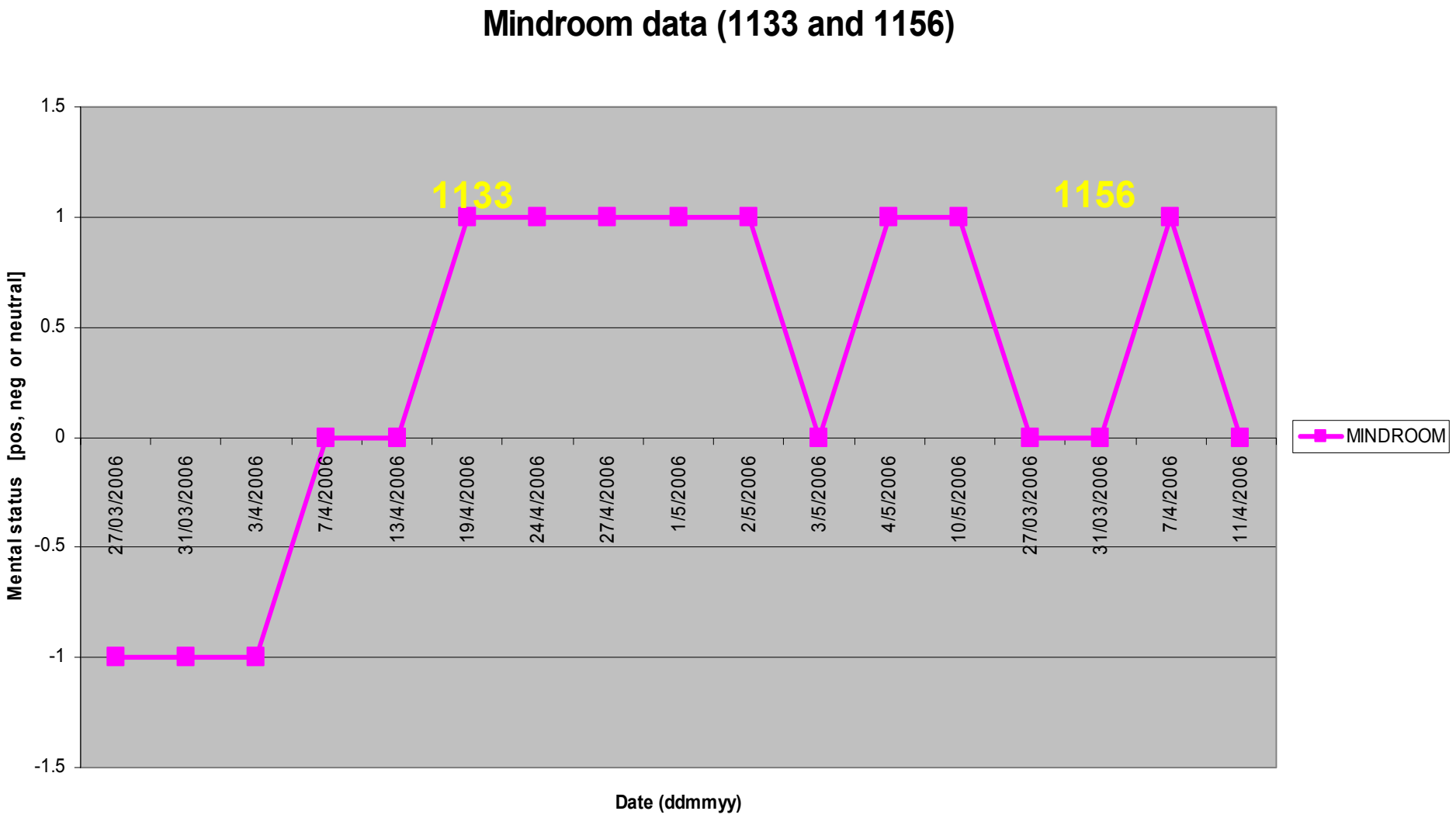
Reference mental status

MINDROOM

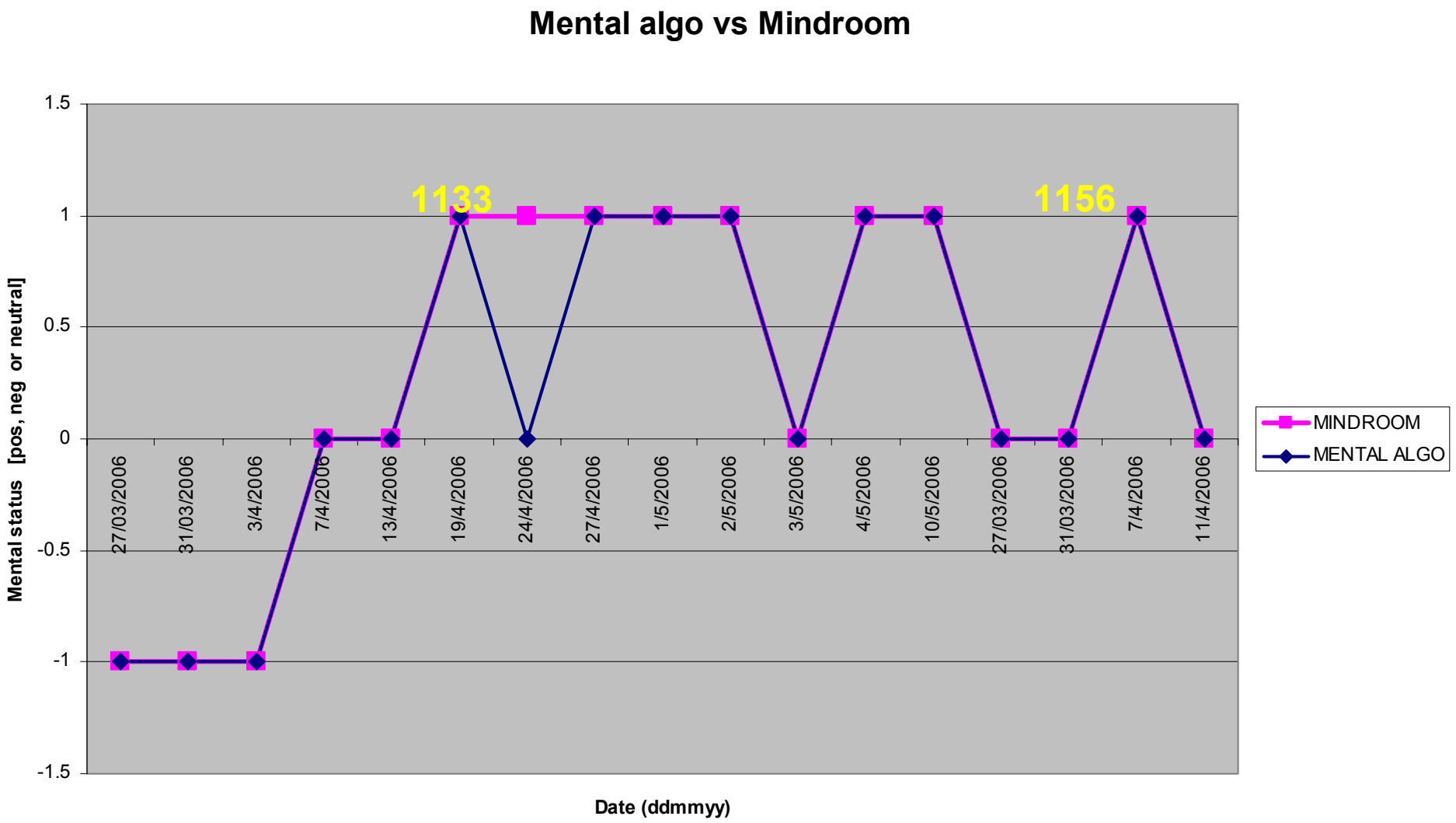
Demo: mental monitoring



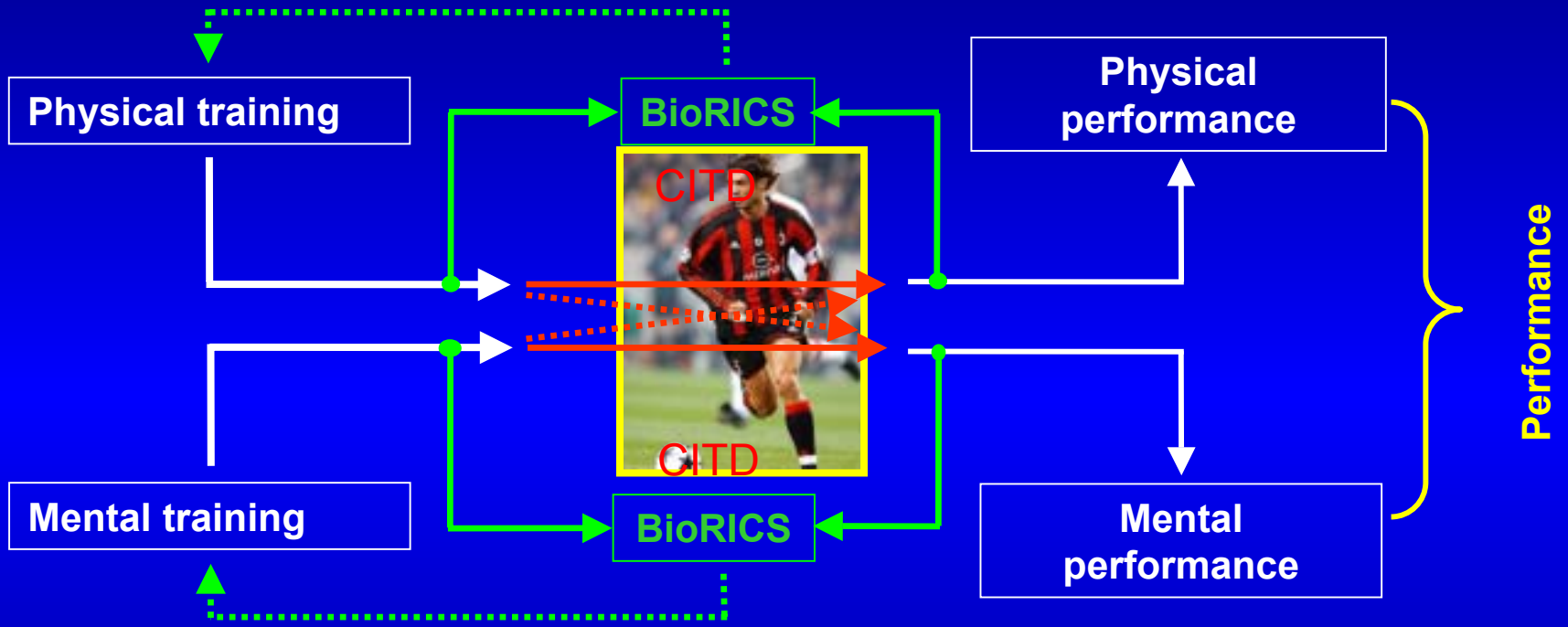
Mindroom vs. Mental algorithm



Mindroom vs. Mental algorithm



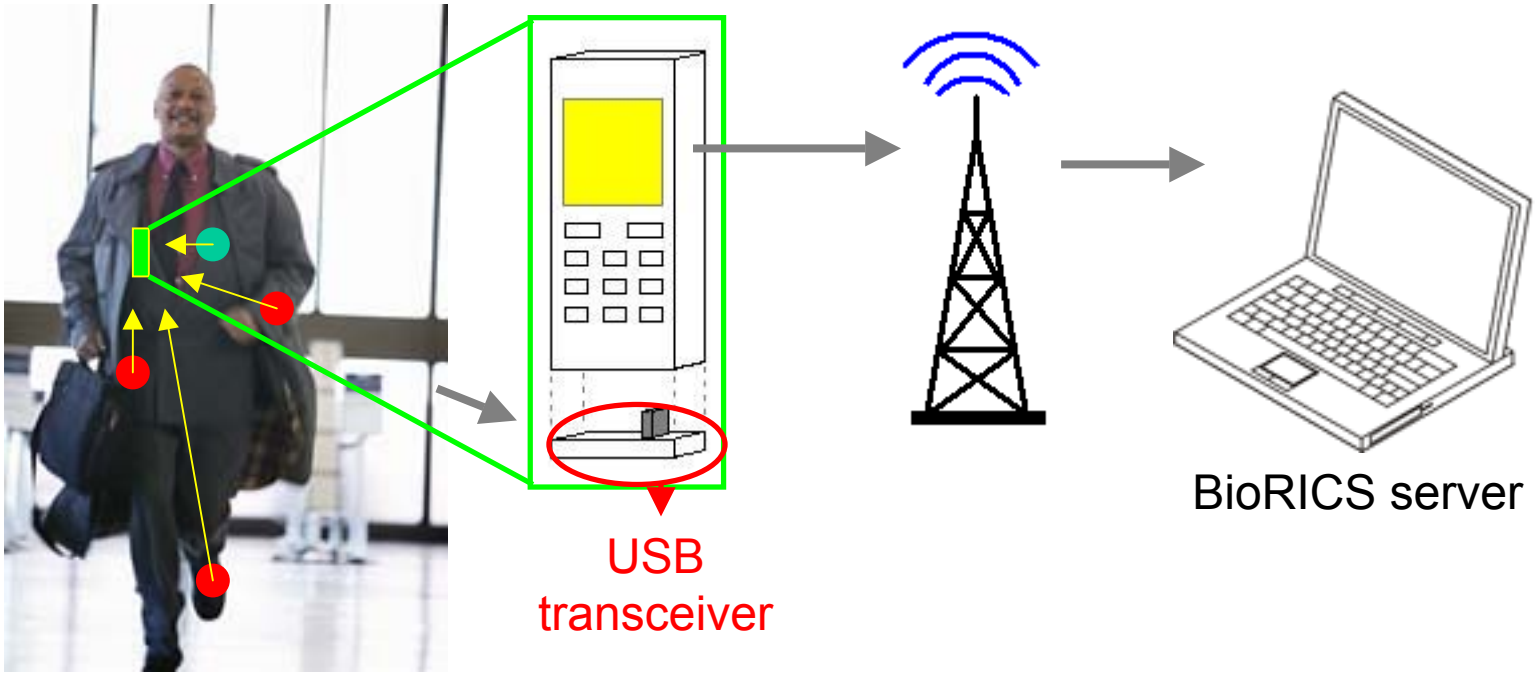
Real-time process control



Total performance = a. Mental performance + b. Physical performance

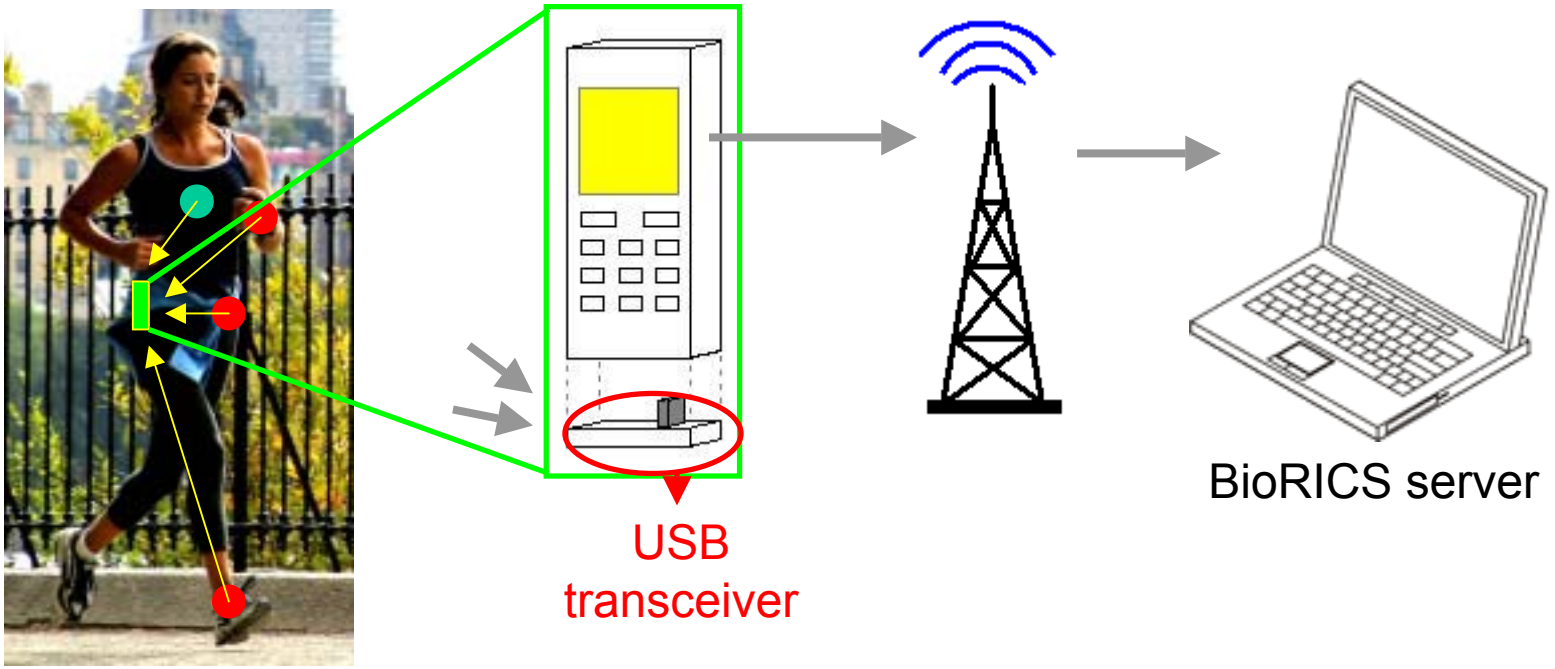
Application Examples

Stressmonitoring



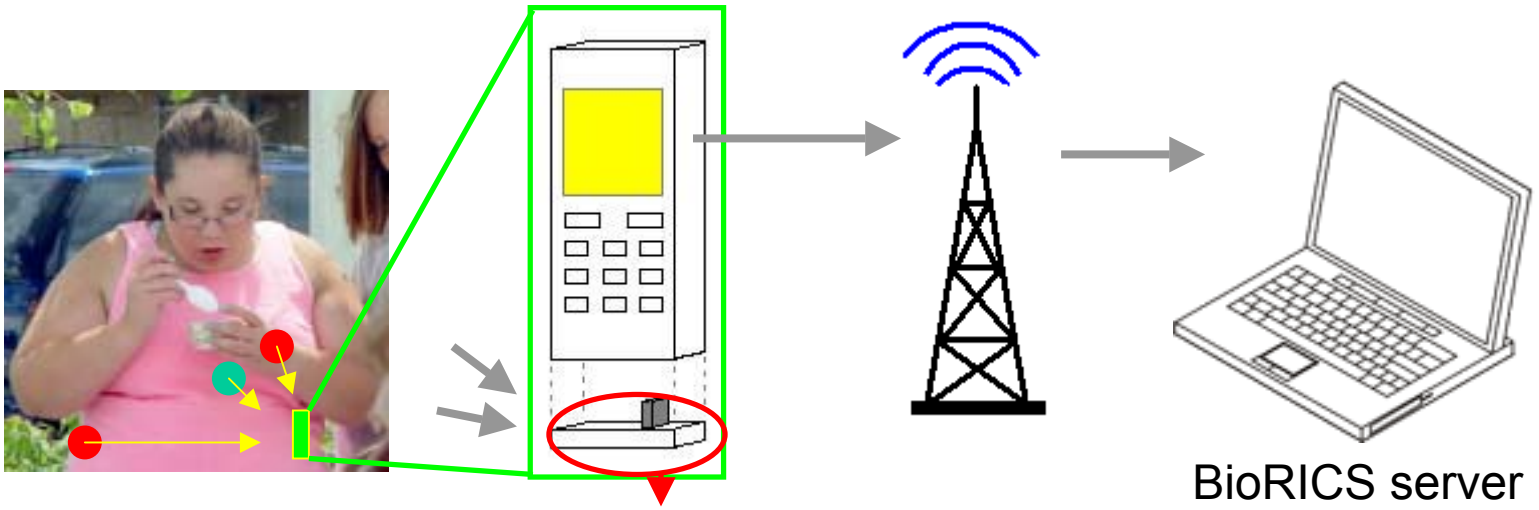
- Accelerometer
- ECG
- Mobile phone

Monitoring and control of physical performance



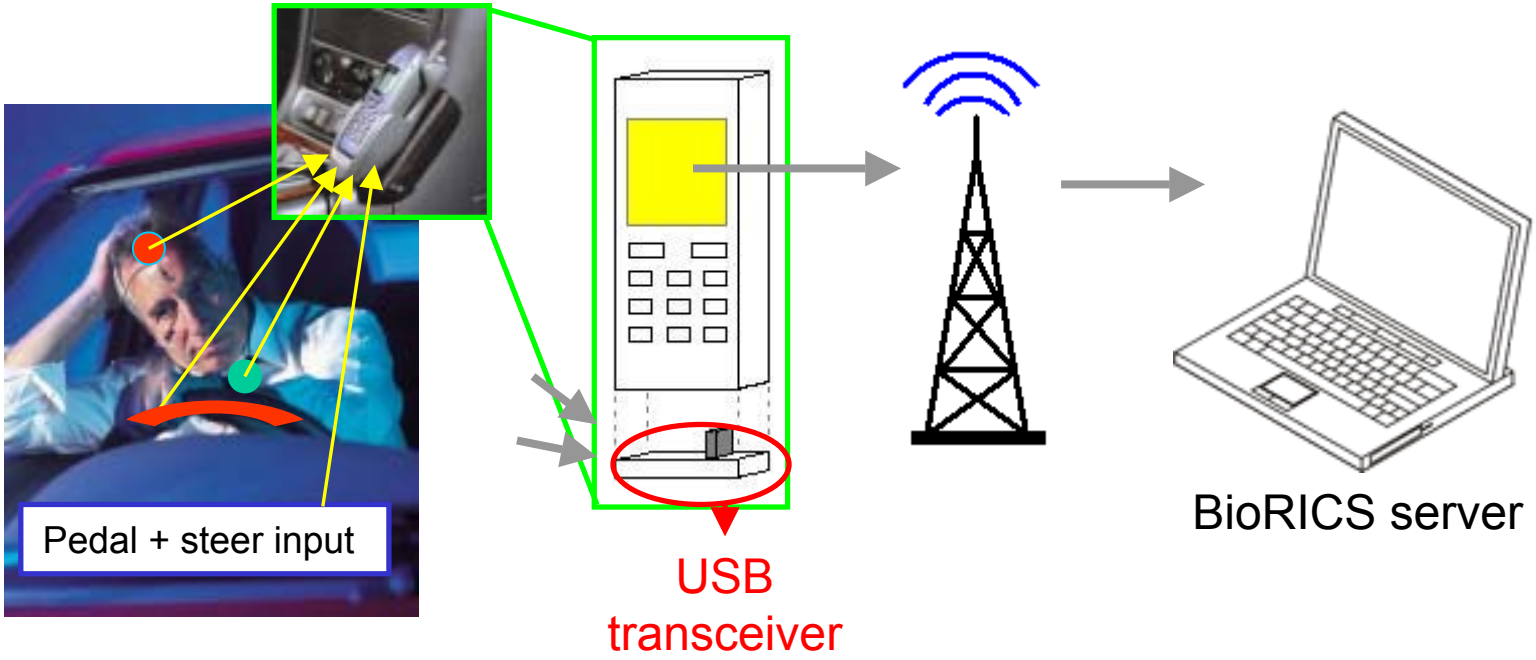
- Accelerometer
- ECG
- Mobile phone

Weight Control



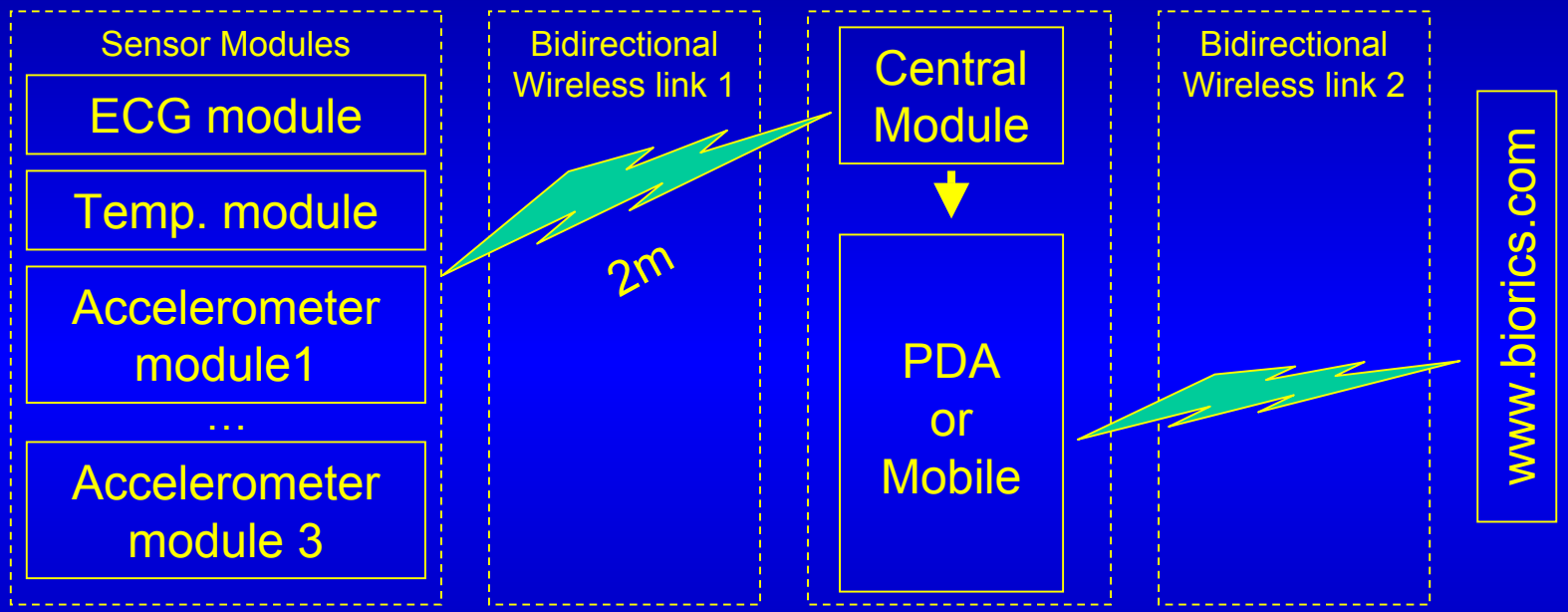
- Accelerometer
- ECG
- Mobile phone

Driver Sleepiness



- Temperature sensor
- ECG

General hardware scheme

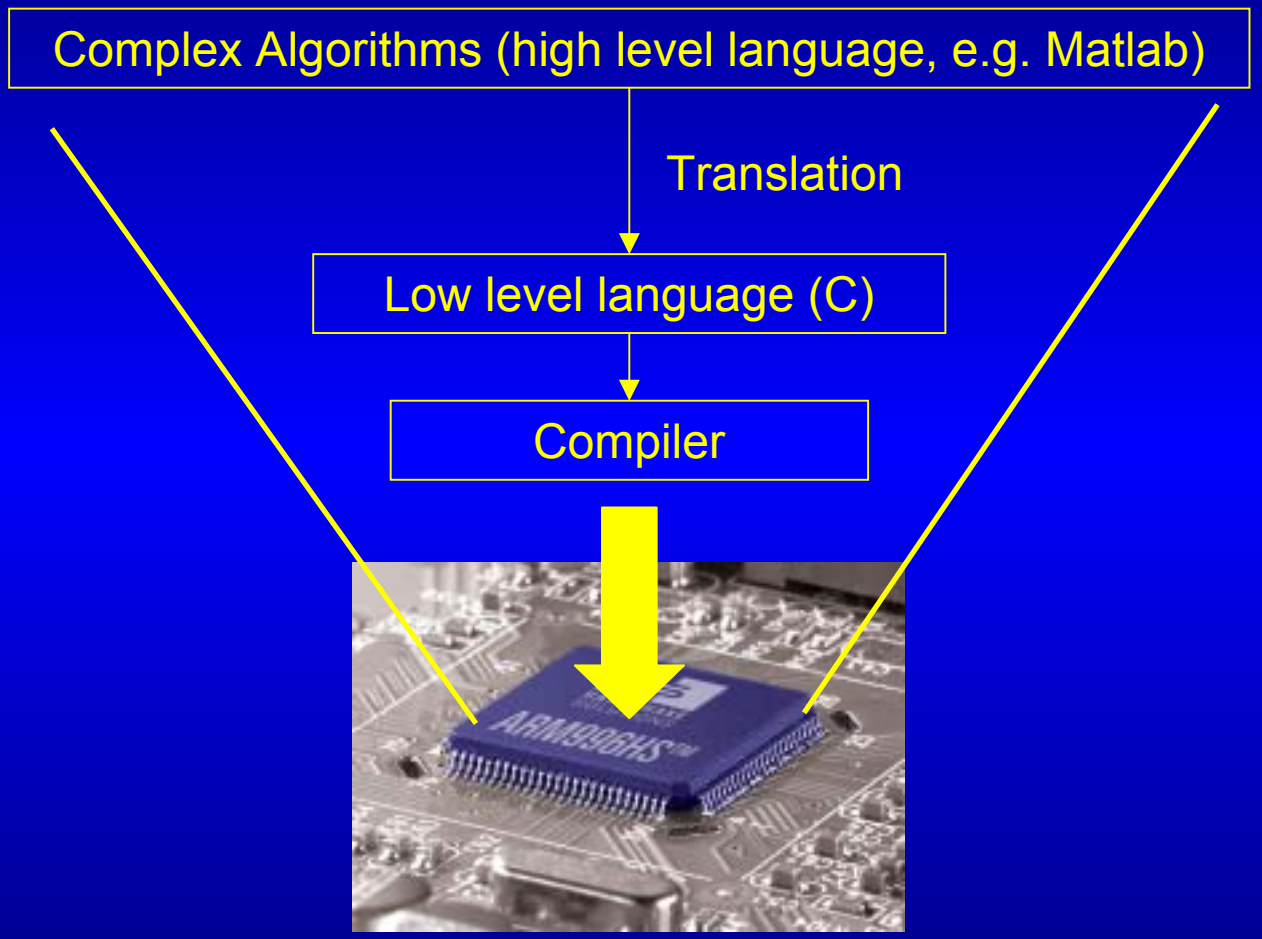


Central Module :

- Transceiver connected to PDA or mobile (mini-USB)
- Responsible for synchronization of the signals from the different sensor modules

Specifications

ECG sensor module :	sampling freq :	300 Hz
Temperature module :	sampling freq :	1/60Hz (1 sample/minute)
Accelerometer modules :	sampling freq :	200 Hz
	g – range :	6g ; 10g ; 25g
	└ Strongly dependent on application field	
Bidirectional Wireless link 1 :	wireless range :	2m
	low power (e.g. recharging after 1 week)	
Central Module :	USB transceiver	
	Synchronization of the different signals form the sensor modules	
	Data transmission via mobile network to BioRICS server	


Complex Algorithms (high level language, e.g. Matlab)
Translation
Low level language (C)
Compiler

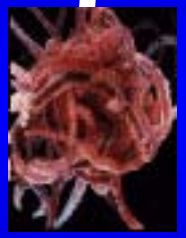
applications

Daphnia

Mussels

Chickens

Tubifex



10 Products

ESA

Intensive Care

Race horses

Bicycle helmets

Professional Cyclists

11 Patents

Thank you for your attention…

- For more information you can always check our website:
  - **http://www.m3-biores.be**
  - **http://www.biorics.com**