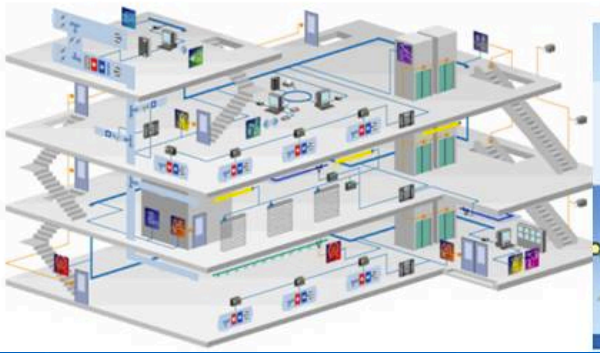


Petrobras/UnB

System Identification
Model-based Predictive Control
Deep Neural Networks
Internet of Things
Building Automation
Energy Saving
Smart Cities

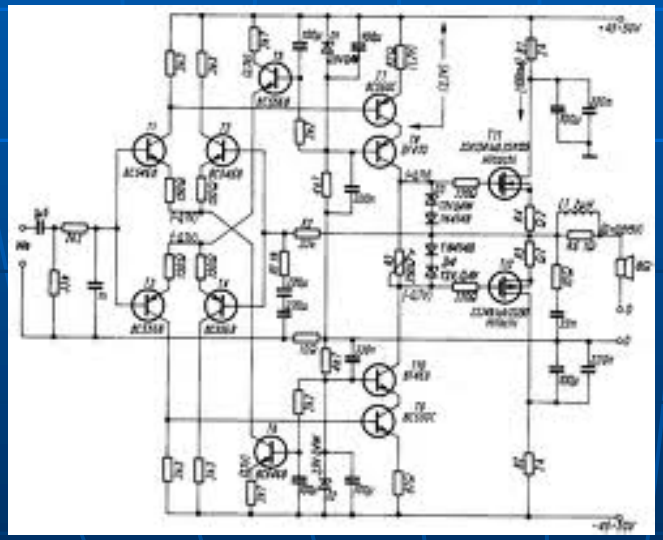
Prof. Adolfo Bauchspiess

LARA- Laboratório de Automação e Robótica
Departamento de Engenharia Elétrica
Universidade de Brasília - Brasil

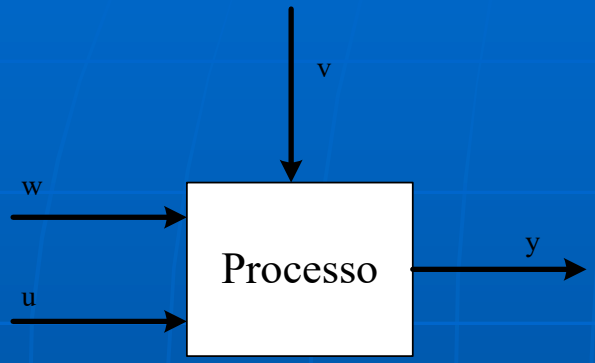
Identificação de Sistemas

Modelos:

- Caixa Branca
- Caixa Preta
- Caixa Cinza



Processo de nível 4ª ordem



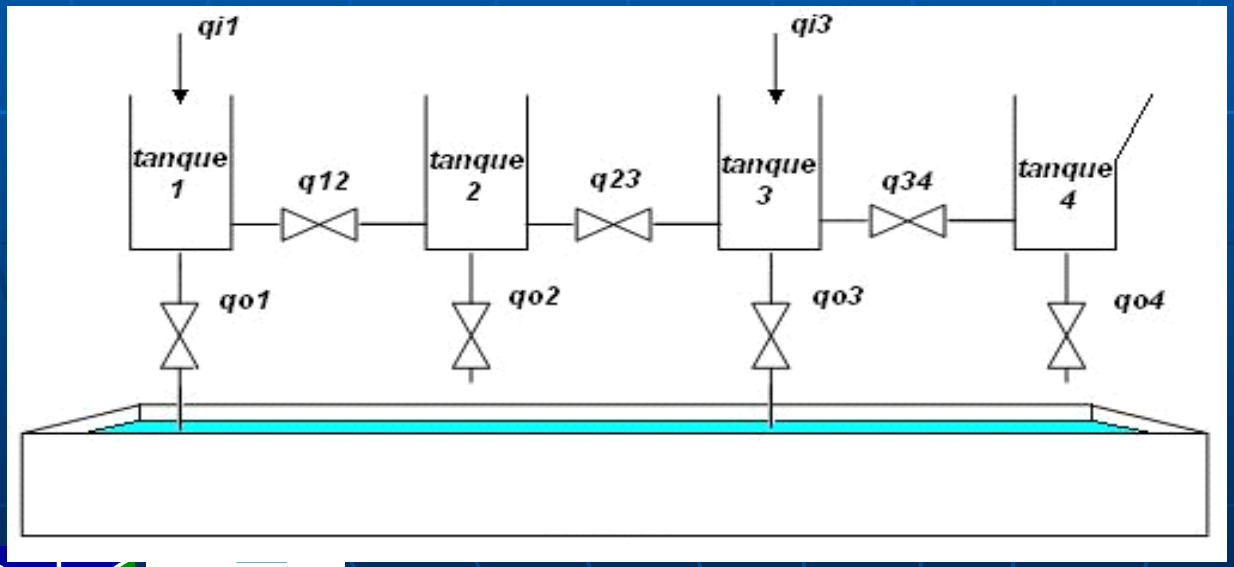
Sinais:

u – *qi1*, vazão [cm³/s]

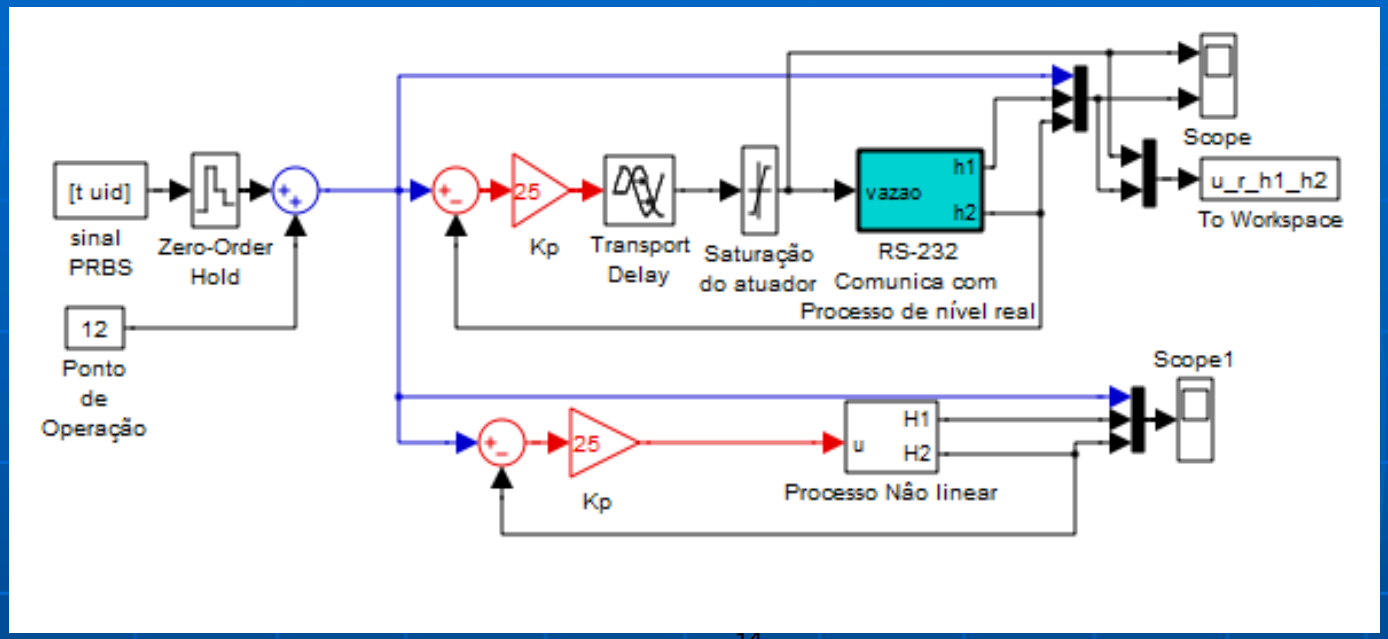
y – nível [cm]

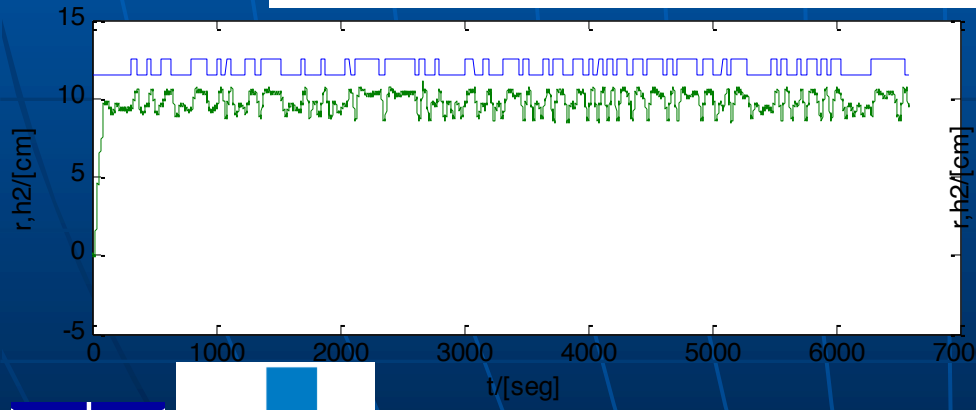
w – *qi3*

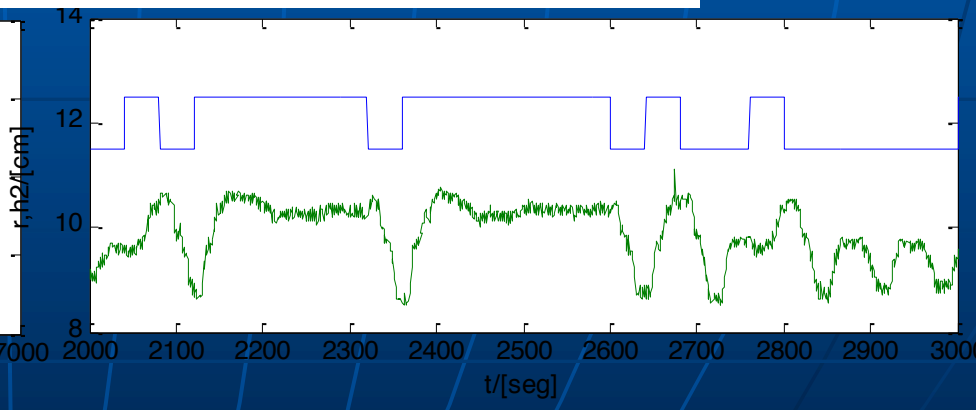
v – ?



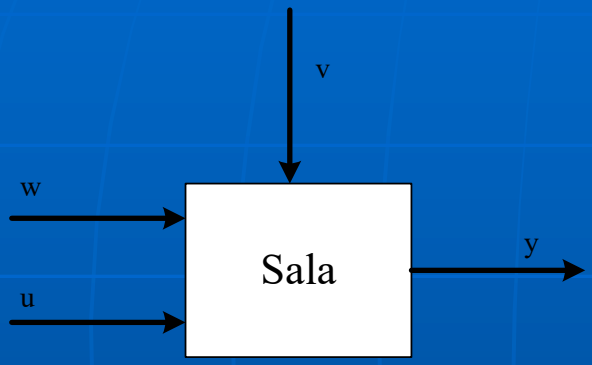
Identificação em Malha Fechada:



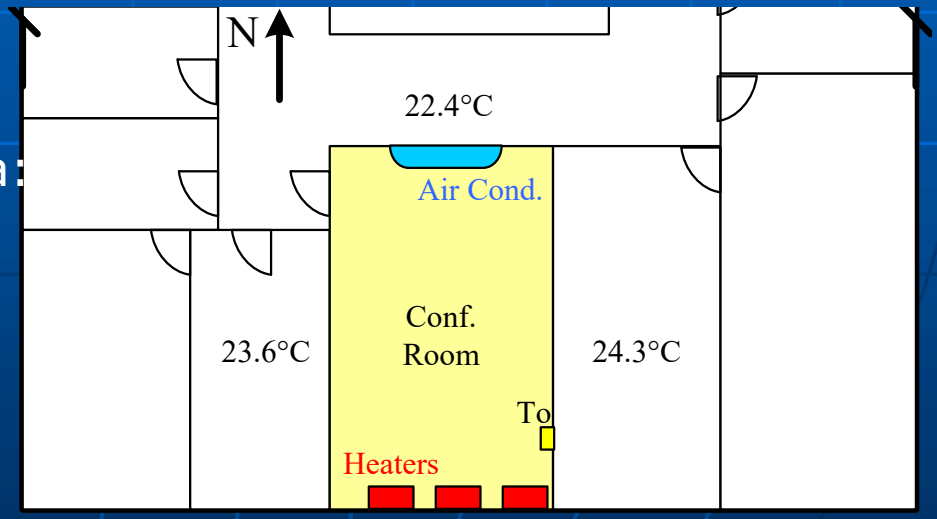




Exemplo – Conforto Térmico



Sistema:



Sinais:

- u – ar condicionado, calefação
- y – temperatura
- w – temperatura externa
- v – radiação solar

Smart Cities

- The Electrical Engineering Perspective

Technologies

- Smart everything
- Examples

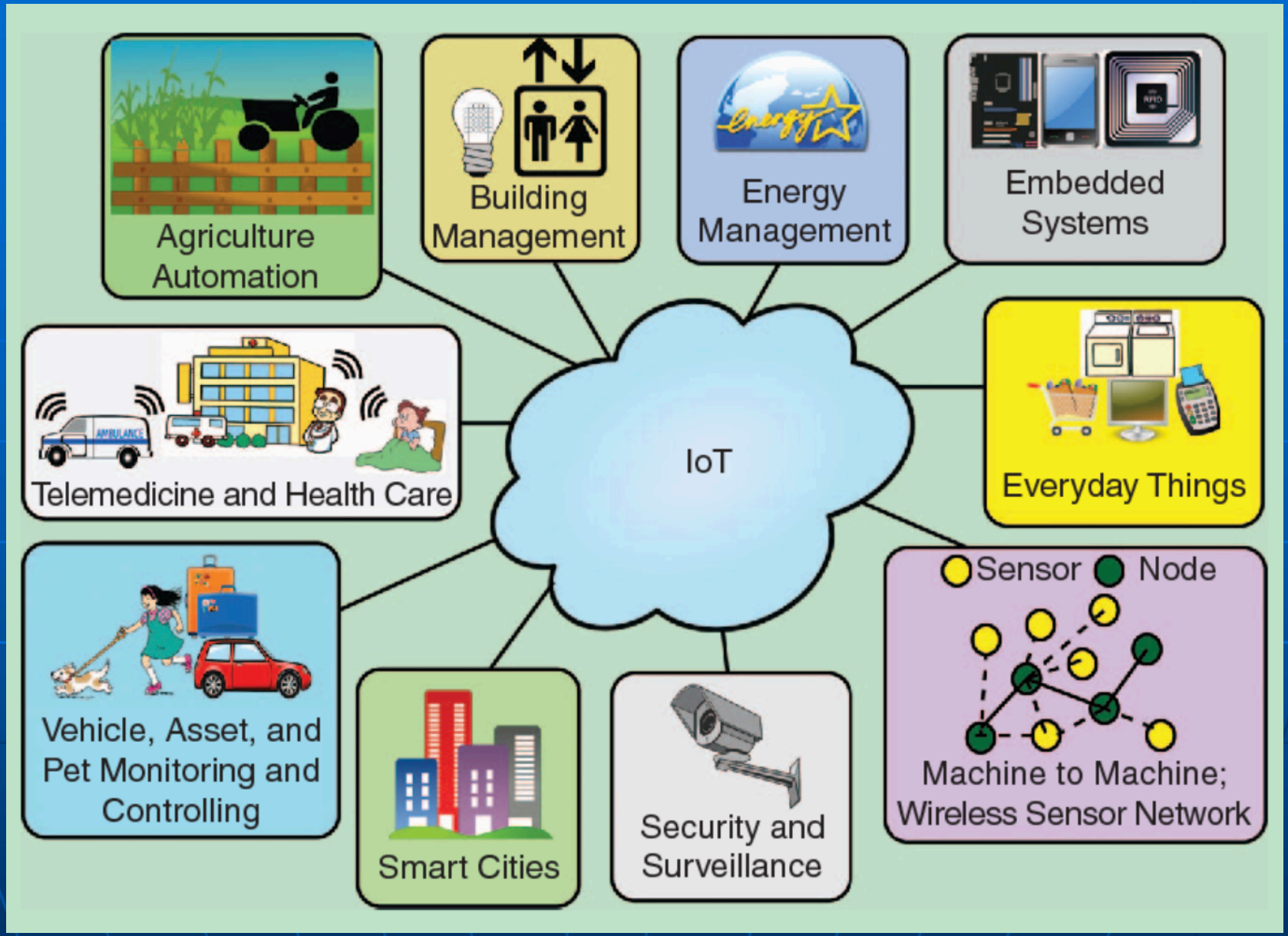
Electrical Eng. Areas:

- TIC
- Electronics
- Power Systems
- Network Engineering
- Control & Automation

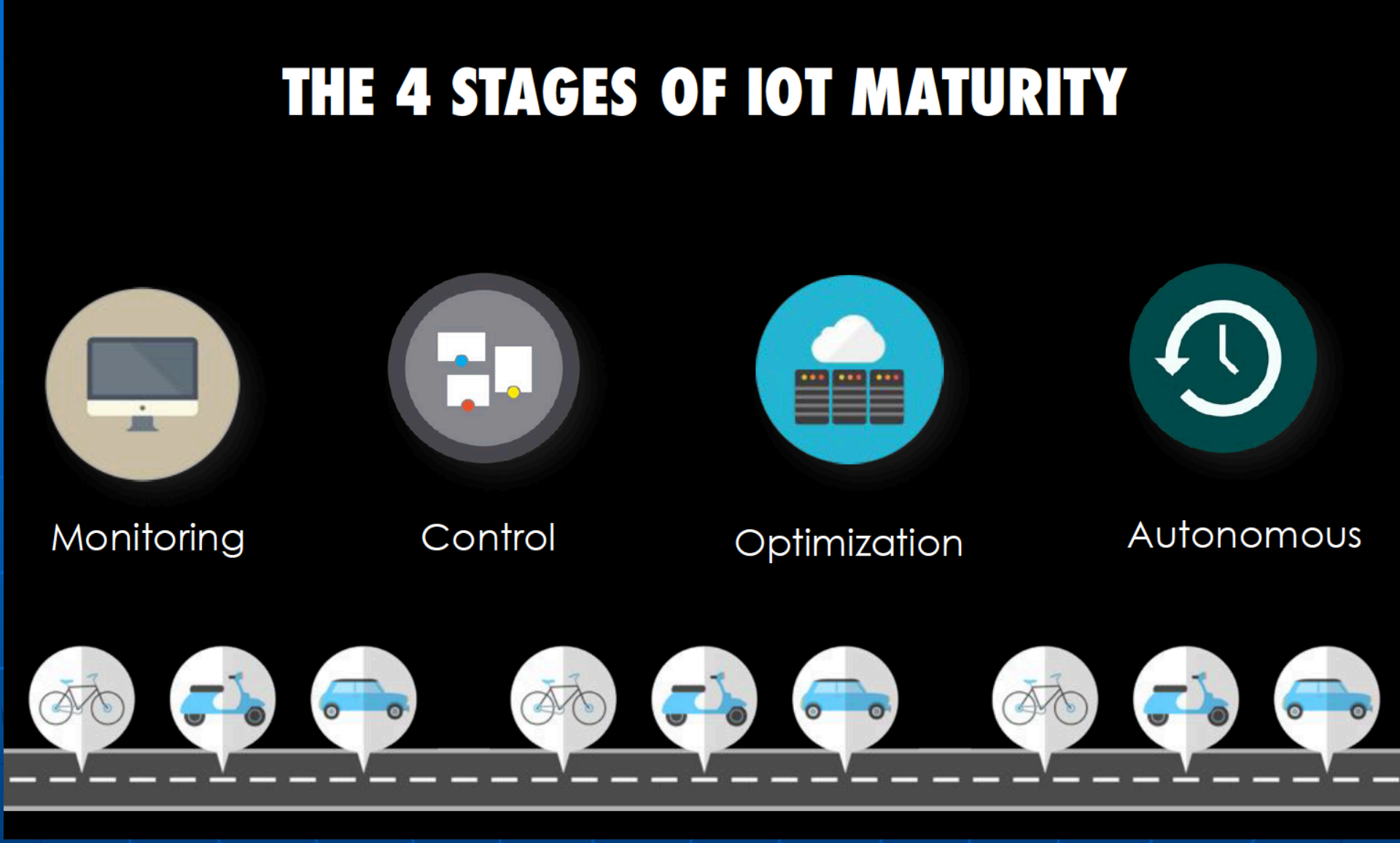
http://perso.limsi.fr/jps/enseignement/examsma/2004/BHATTI/

“Hot Spots”

- *Cybernetics*
- *Artificial Intelligence (e.g. Deep Learning)*
- *Machine Learning*
- *Pervasive Computing*
- *Assisted Living*
- *Mechatronics*
- *Ambient Intelligence*
- *Cyber Physical Systems*
- *ZEB – Zero Energy Buildings*
- ***Smart** Environments / Buildings / Campus / Cities*



https://www.researchgate.net/publication/306046857_Everything_You_Wanted_to_Know_About_Smart_Cities/figures?lo=1



https://www.slideshare.net/mazlan1/introduction-to-iot-smart-city/18-FUNCTIONAL_VIEW_OF_IOTTECHNOLOGIES

M C O A

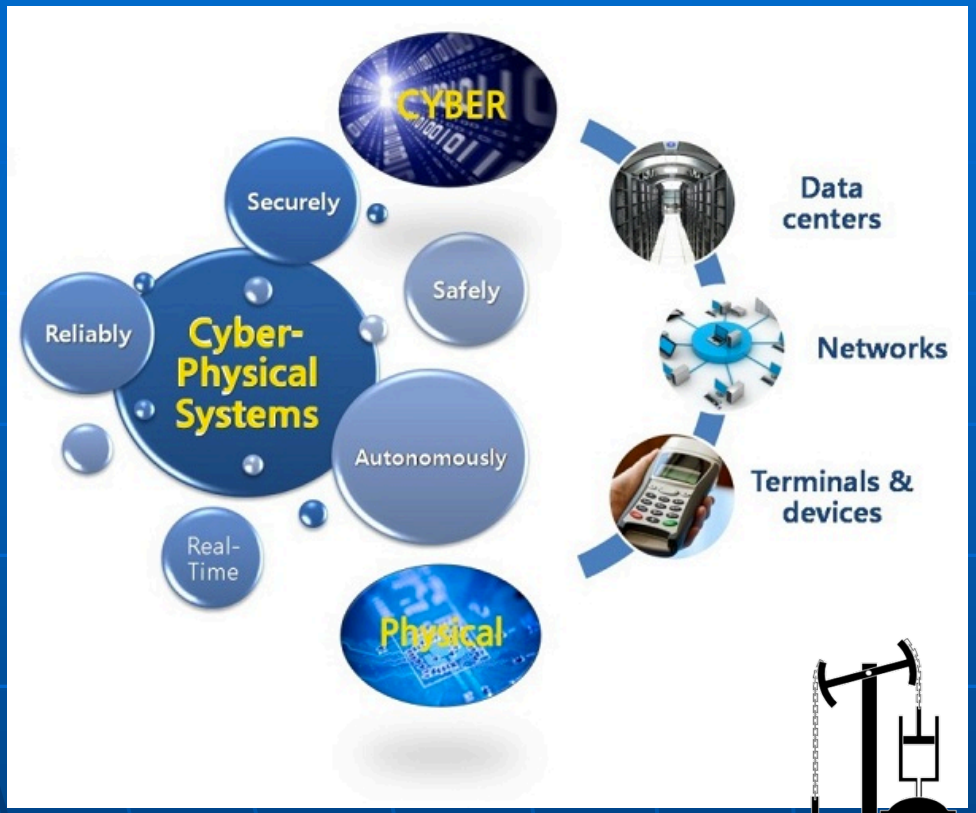
IoT → Big Data → AI → CPS

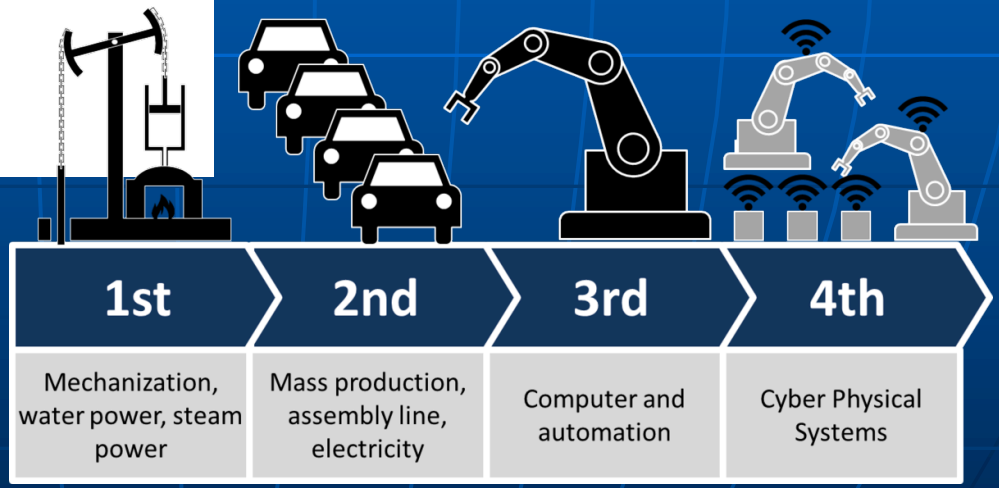
Sensor	Cloud Storage	Machine Learning	Digital Twin
NB-IoT/5G	Hadoop/Spark	Deep Learning	Co-bot
LoRa/Sigfox	ETL	Cloud computing	AV
MQTT	Cleansing	Edge computing	MR
CoAP	Anonymized	Quantum computing	
EPC,UCode	Blockchain		

https://www.nstda.or.th/nac/2019/images/seminar/26_Smartcity_passakorn.pdf

CPS: Cyber—Physical System
Cobot – Collaborative Robot
MR: Maintenance-Repair
ETL: Extract, Transform, Load

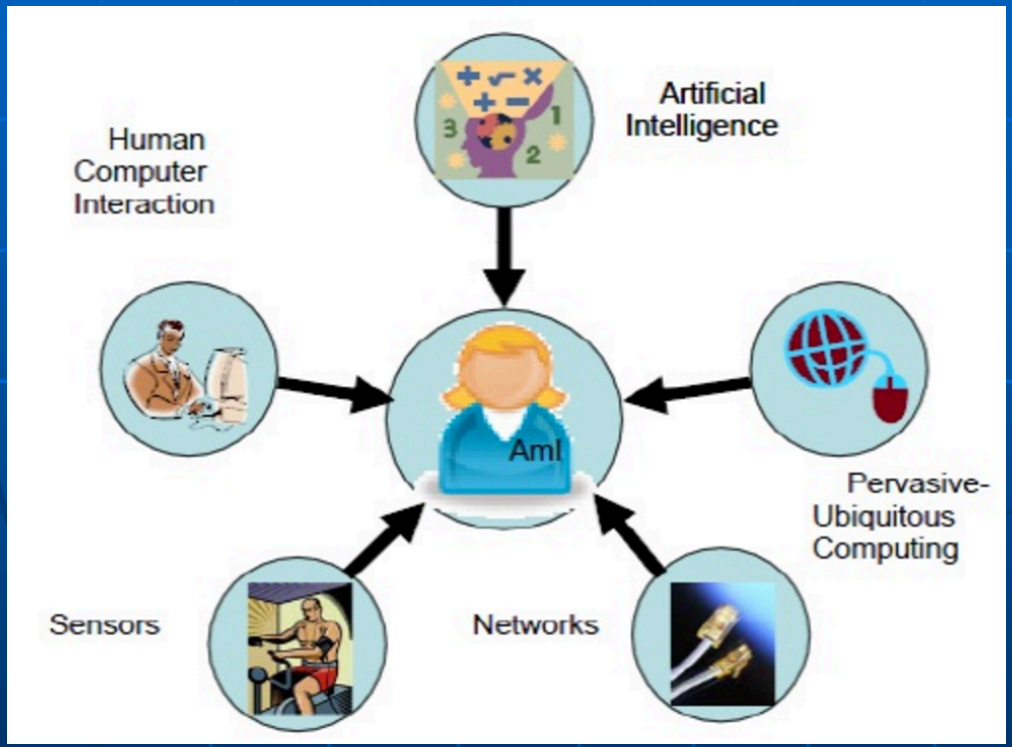
Cyber-Physical Sytems





Ambient Intelligence

"Provides services to the users of an environment through a netwok, almost invisible, of sensors and actuators"



Which services?

Which informations can be obtained, from the Cloud? IOT?

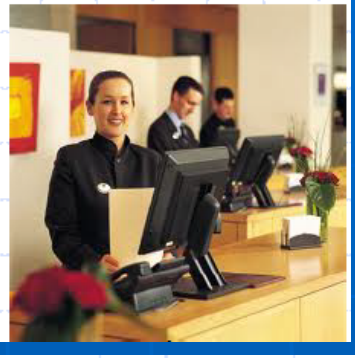
What is "intelligent"?

(adaptation /learning /innovation)?

Building Automation Segments

- ✓ Schools
- ✓ Hospitals
- ✓ Hotels
- ✓ Pharma
- ✓ Commercial
- ✓ Airports
- ✓ Stadiums
- ✓ Domotics
- ✓ …

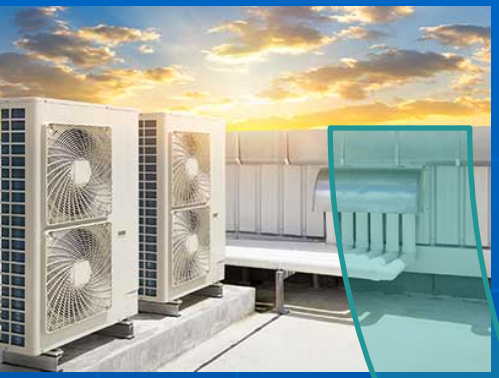








Subsystems

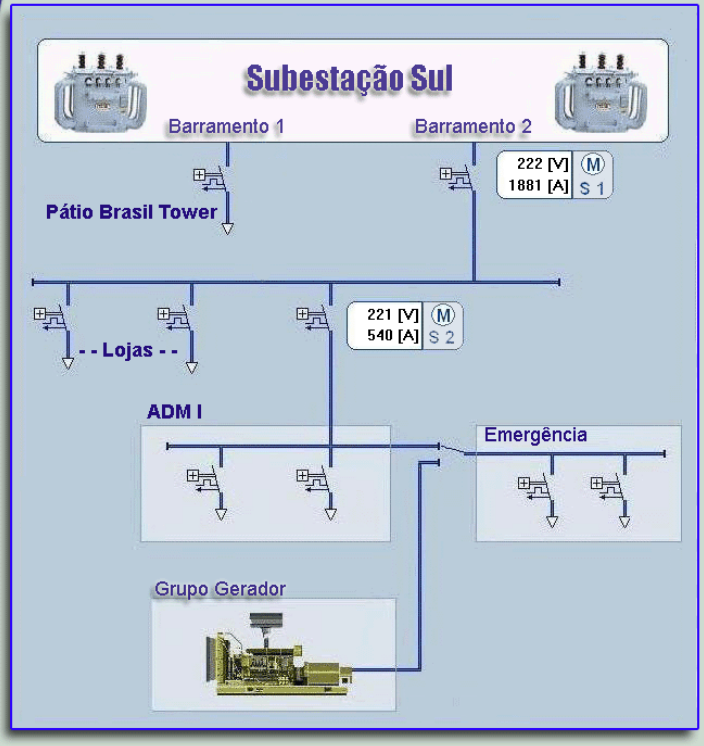


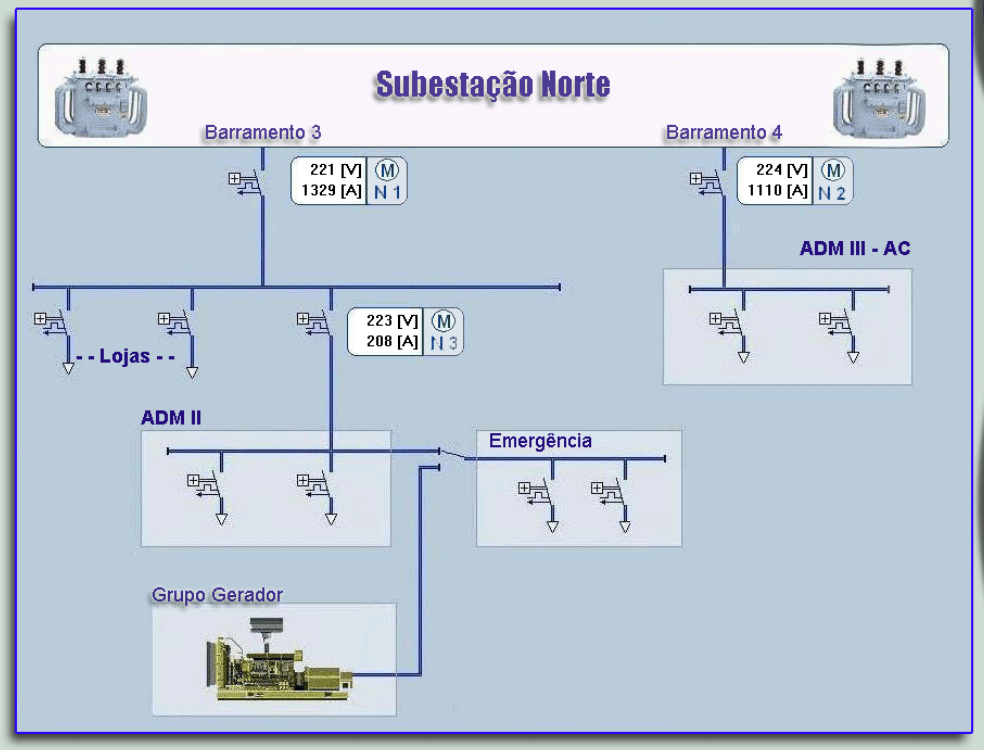
- ✓ HVAC
- ✓ Illumination
- ✓ Fire
- ✓ Energy
- ✓ Generator Group
- ✓ CFTV
- ✓ Access Control
- ✓ Elevators/Escalators
- ✓ …

Energia Elétrica - Circuitos Alimentadores

PÁTIO BRASIL SHOPPING

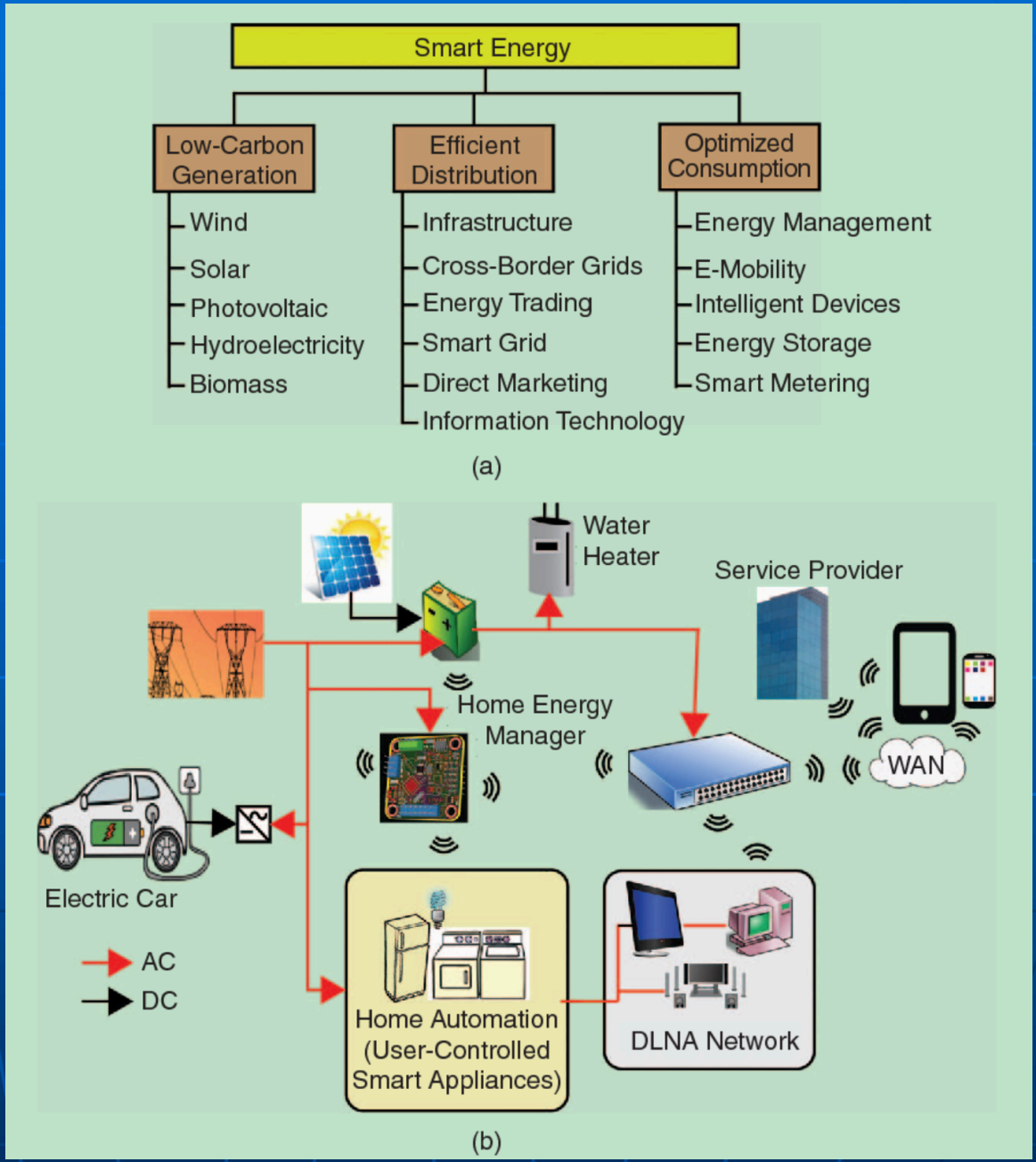
PRINCIPAL





	Alimentador Sul - M S1				ADM I - Medidor M S2				Alimentador Norte - M N1				ADM II - Medidor M N3				ADM III (AC) - Medidor M N2			
	[V]	[A]	FP	[kW]	[V]	[A]	FP	[kW]	[V]	[A]	FP	[kW]	[V]	[A]	FP	[kW]	[V]	[A]	FP	[kW]
FASE R	220	1930	0,89	378130	220	589	0,83	107742	220	1027	0,80	180481	221	211	0,95	44343	224	1090	0,97	236051
FASE S	222	1841	0,88	358394	222	519	0,80	92869	221	1436	0,91	288350	224	184	1,00	41140	224	1161	0,95	248133
FASE T	222	1872	0,88	364930	222	511	0,79	89937	222	1526	0,90	305239	223	227	0,97	48998	225	1080	0,95	229506
MÉDIA	222	1881	0,88	101455	221	540	0,81	290548	221	1329	0,88	774071	223	208	0,97	134481	224	1110	0,96	713690

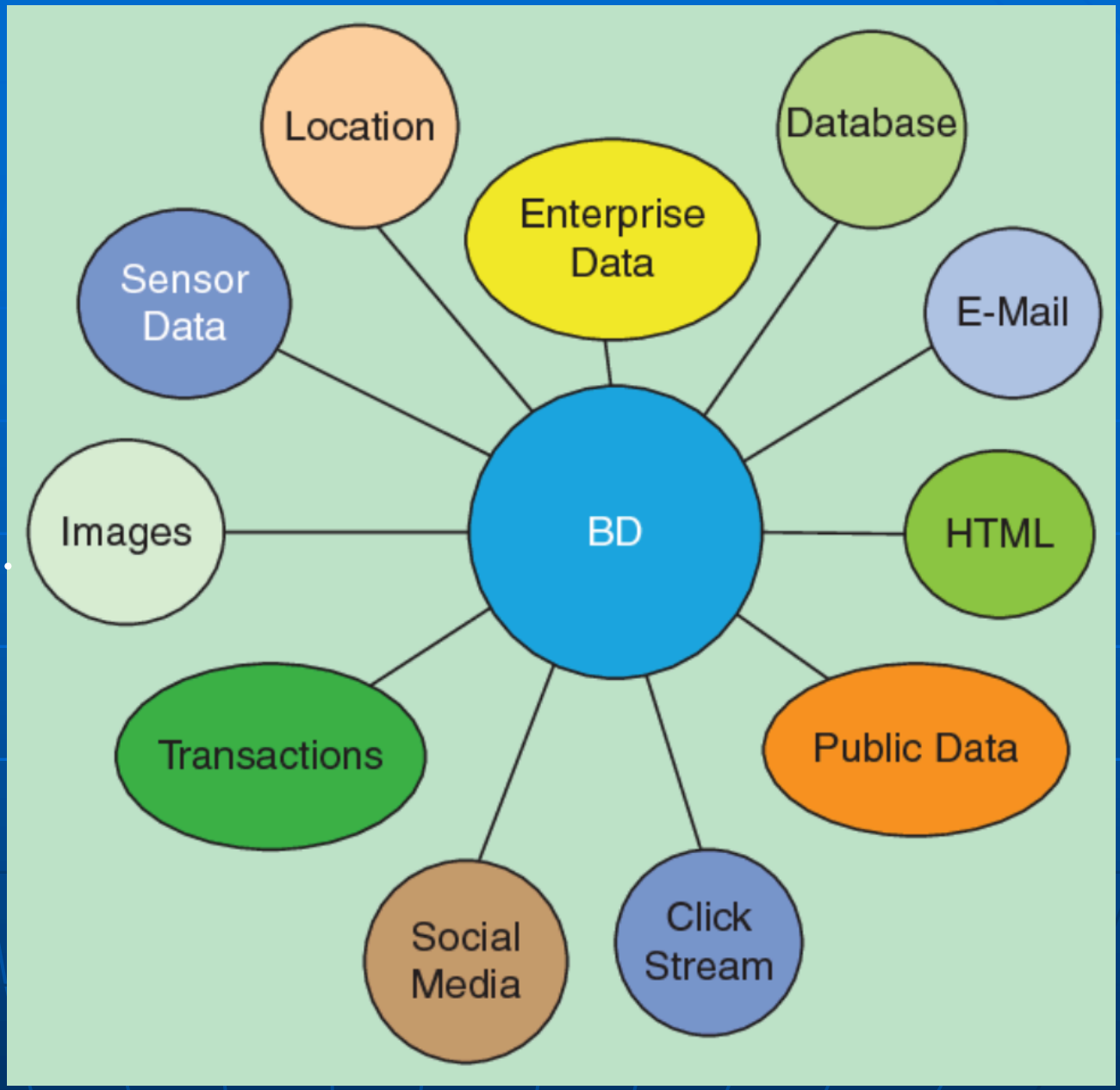
a) Smart energy and
b) A smart energy system



https://www.researchgate.net/publication/328270031_Virtual_power_plants_Powering_smart_cities_of_the_future/figures?lo=1

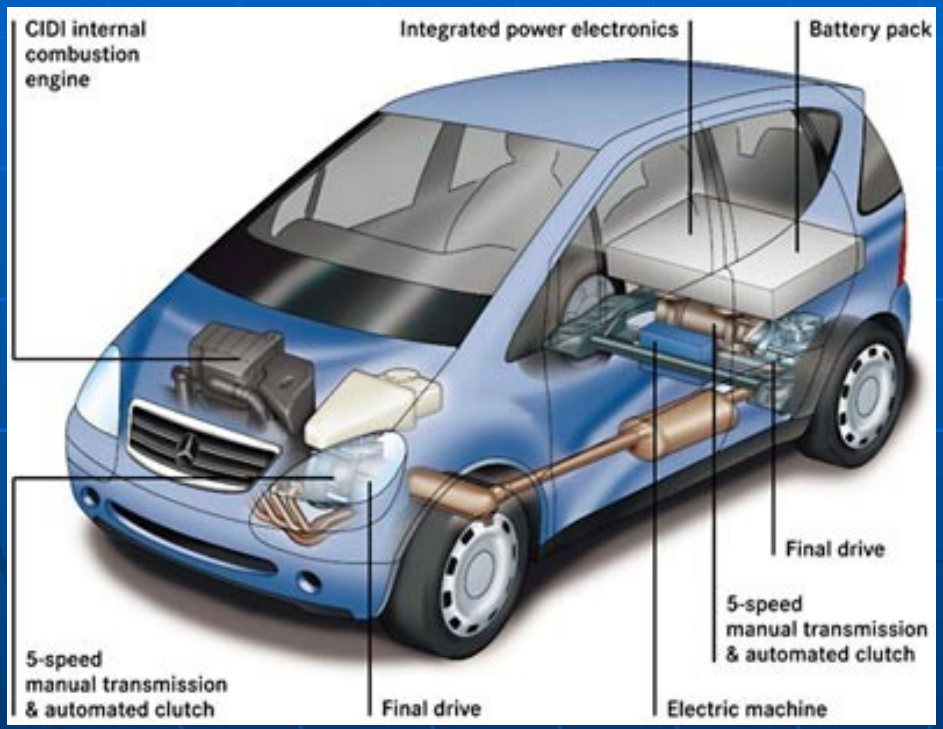
Big Data

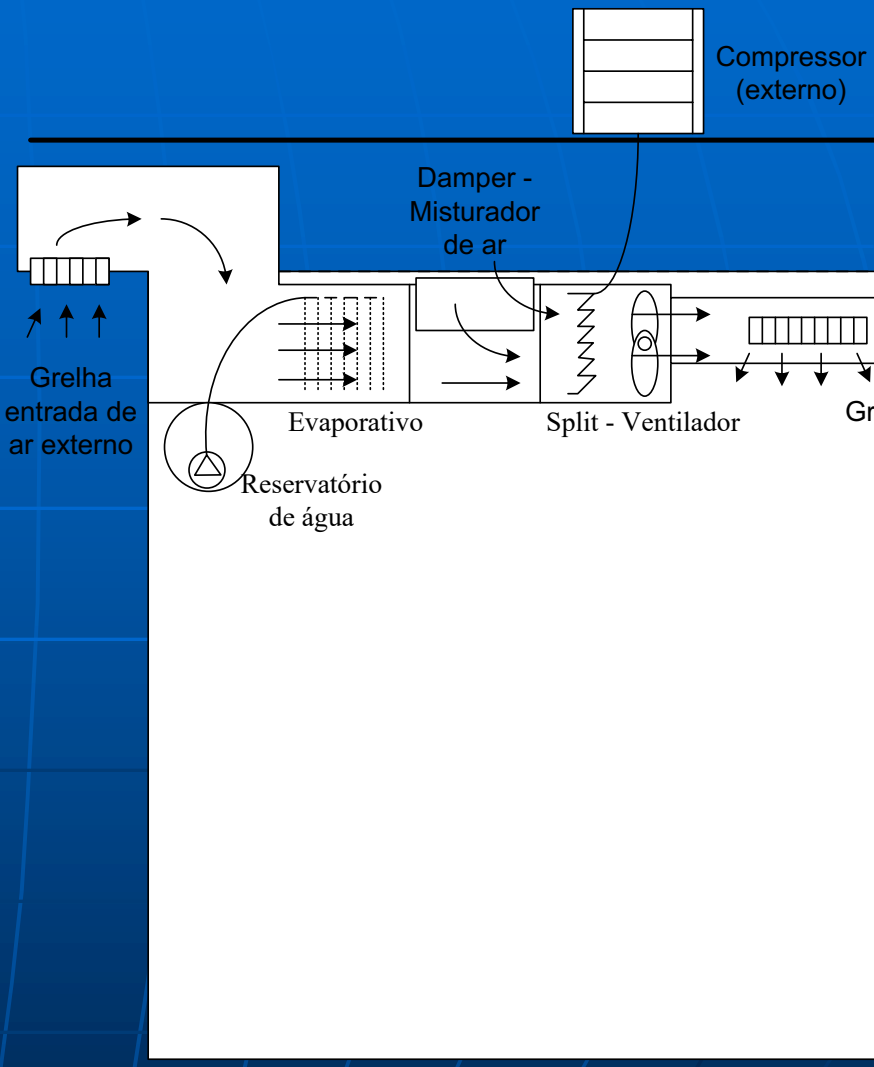
(**and now** more…
Big **Action!**)



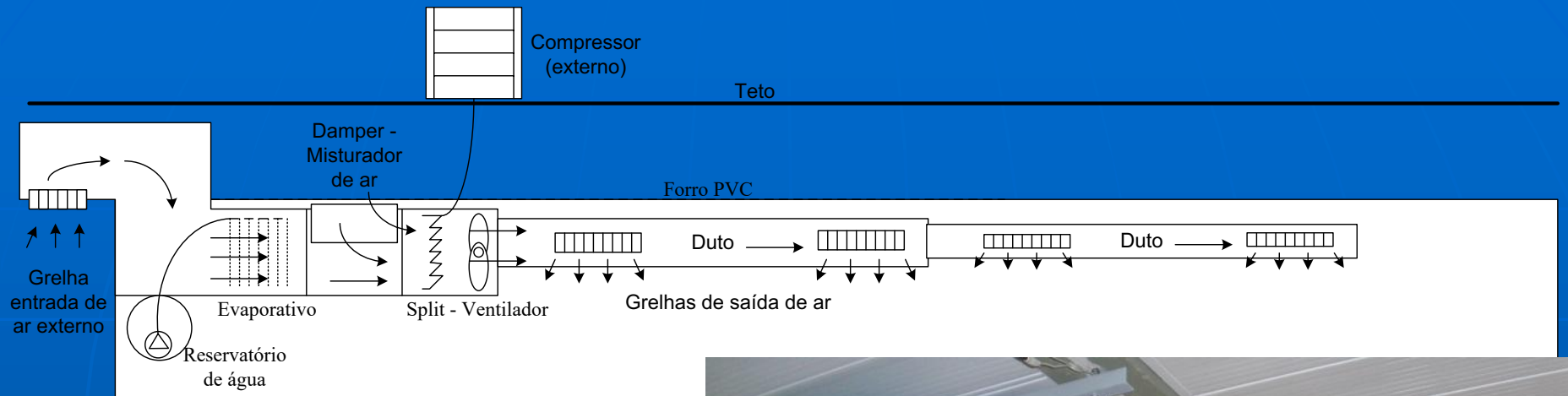
https://www.researchgate.net/publication/306046857_Everything_You_Wanted_to_Know_About_Smart_Cities/figures?lo=1

Energy Efficiency:
Hybrid Car Hybrid Ar-Conditioning





Hybrid Air Conditioning

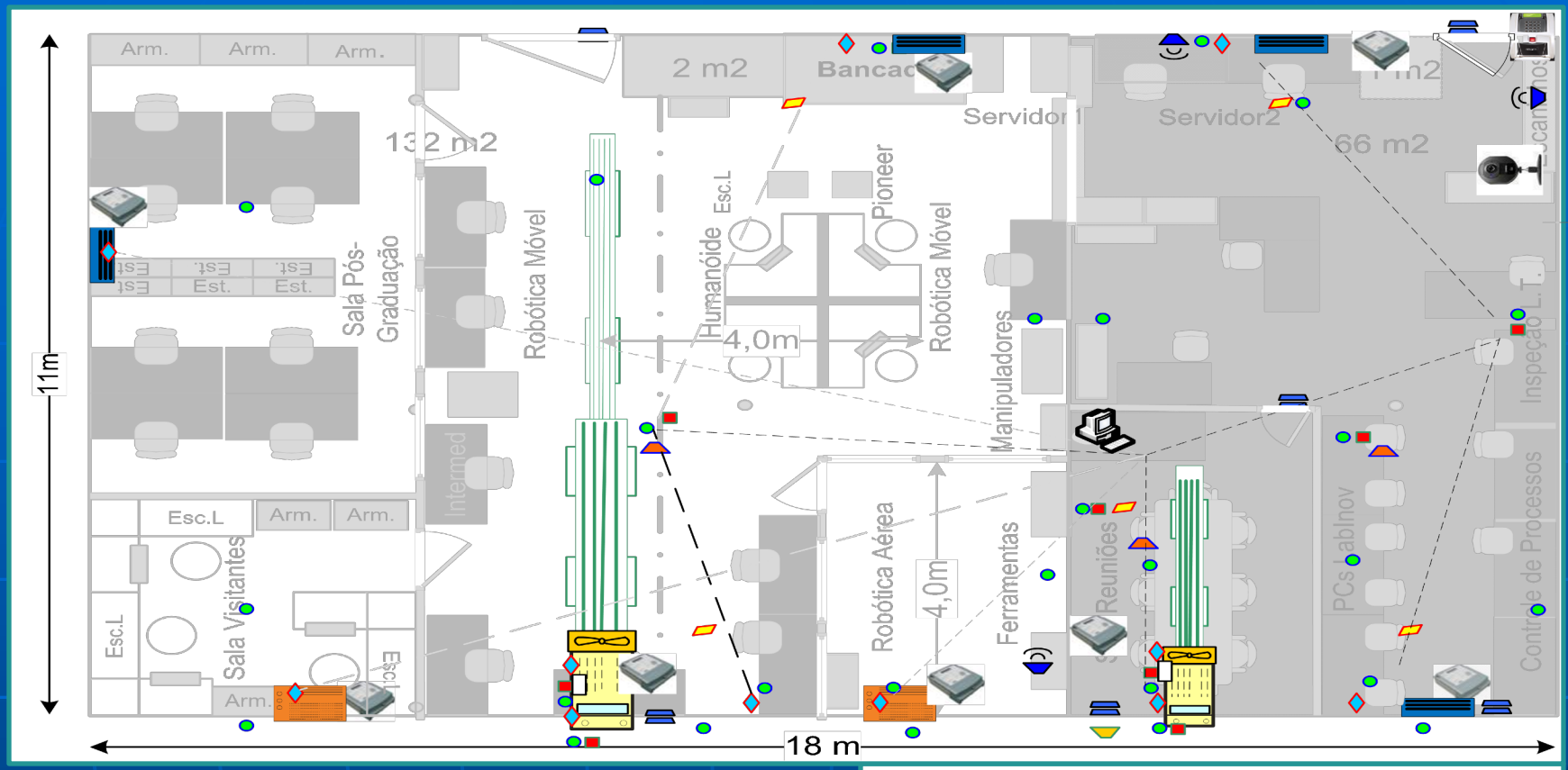


Energy
(24 hours)

Conventional	5,92 kWh
Hybrid	1,95 kWh

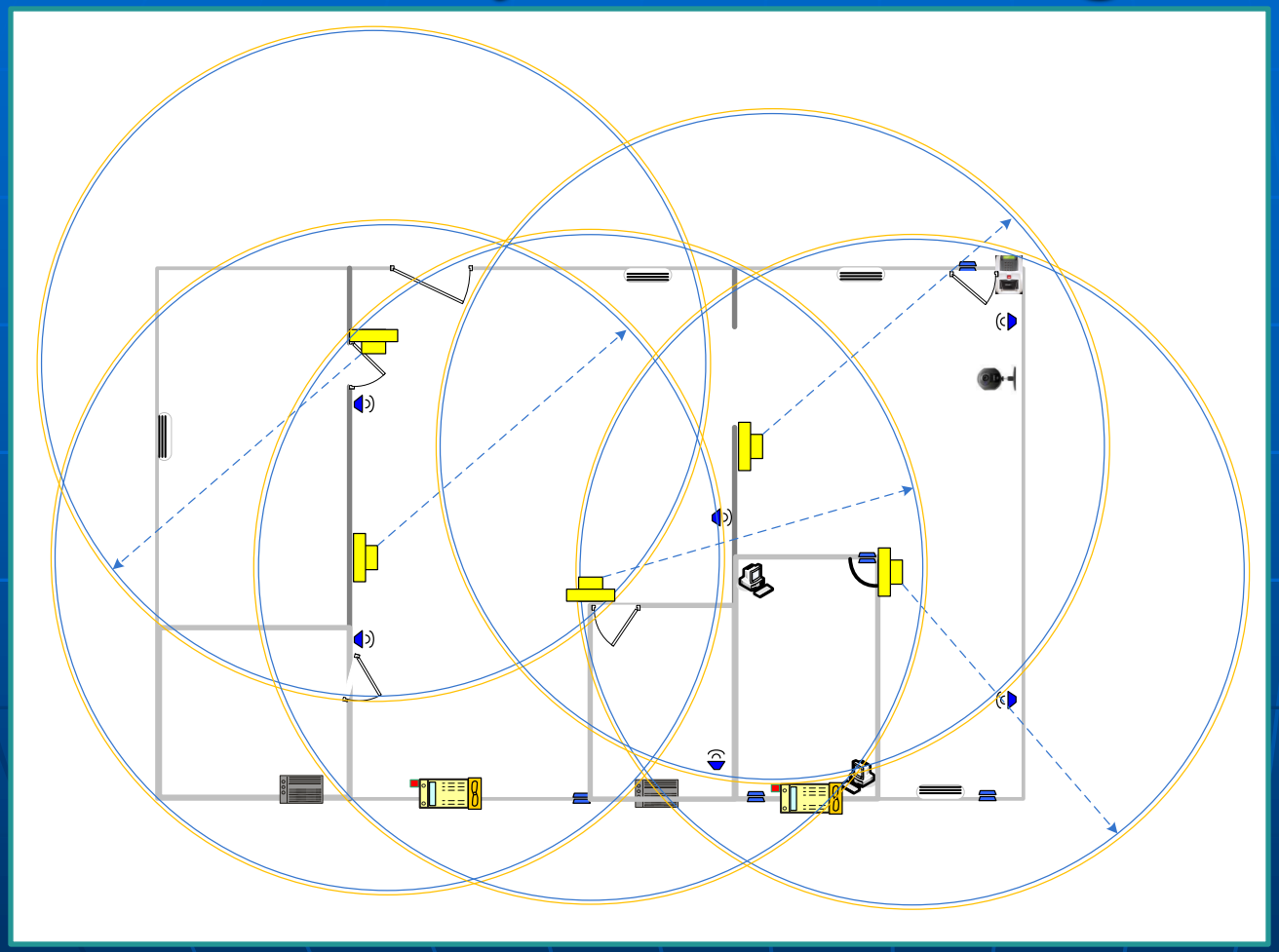
70% reduction!!

Sensors and Actuators



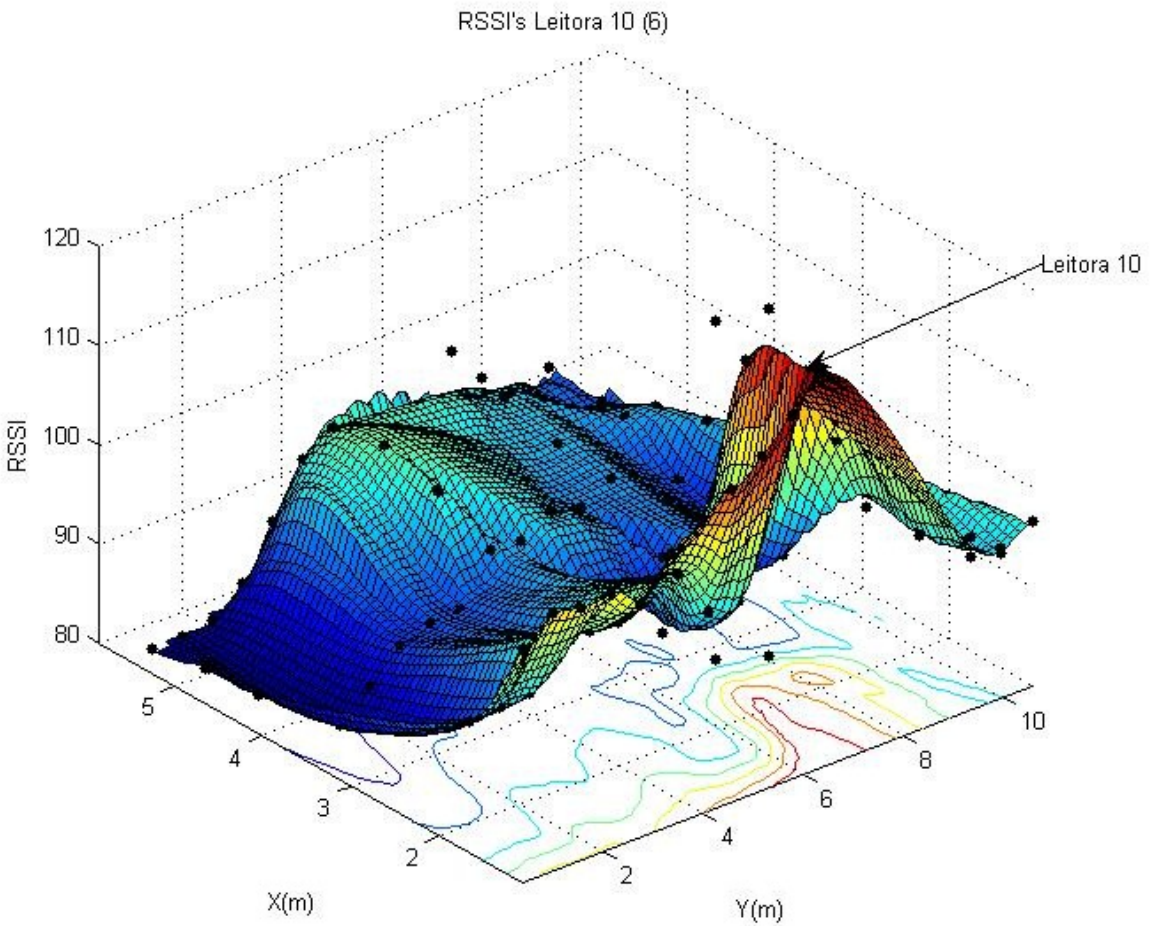
LARA Laboratório de Automação e Robótica - ENE/UnB

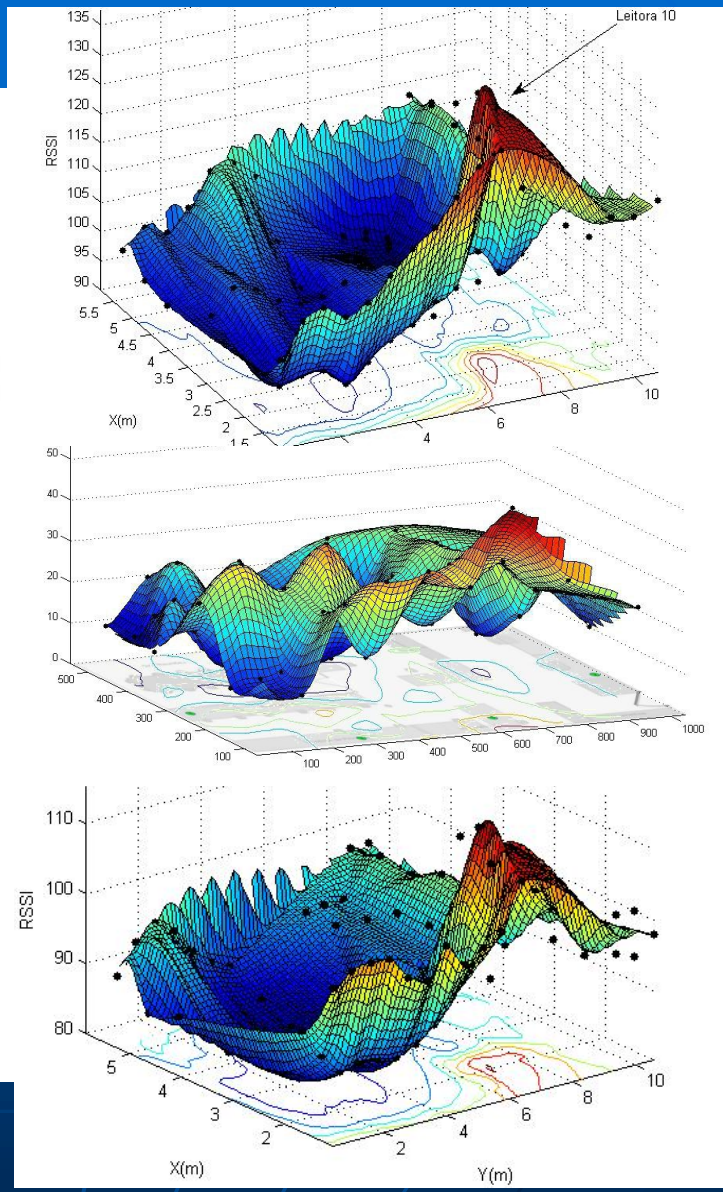
Thermal Load Estimation by RFID triangulation



SSI Mapping (Received Signal Strength Indicator)

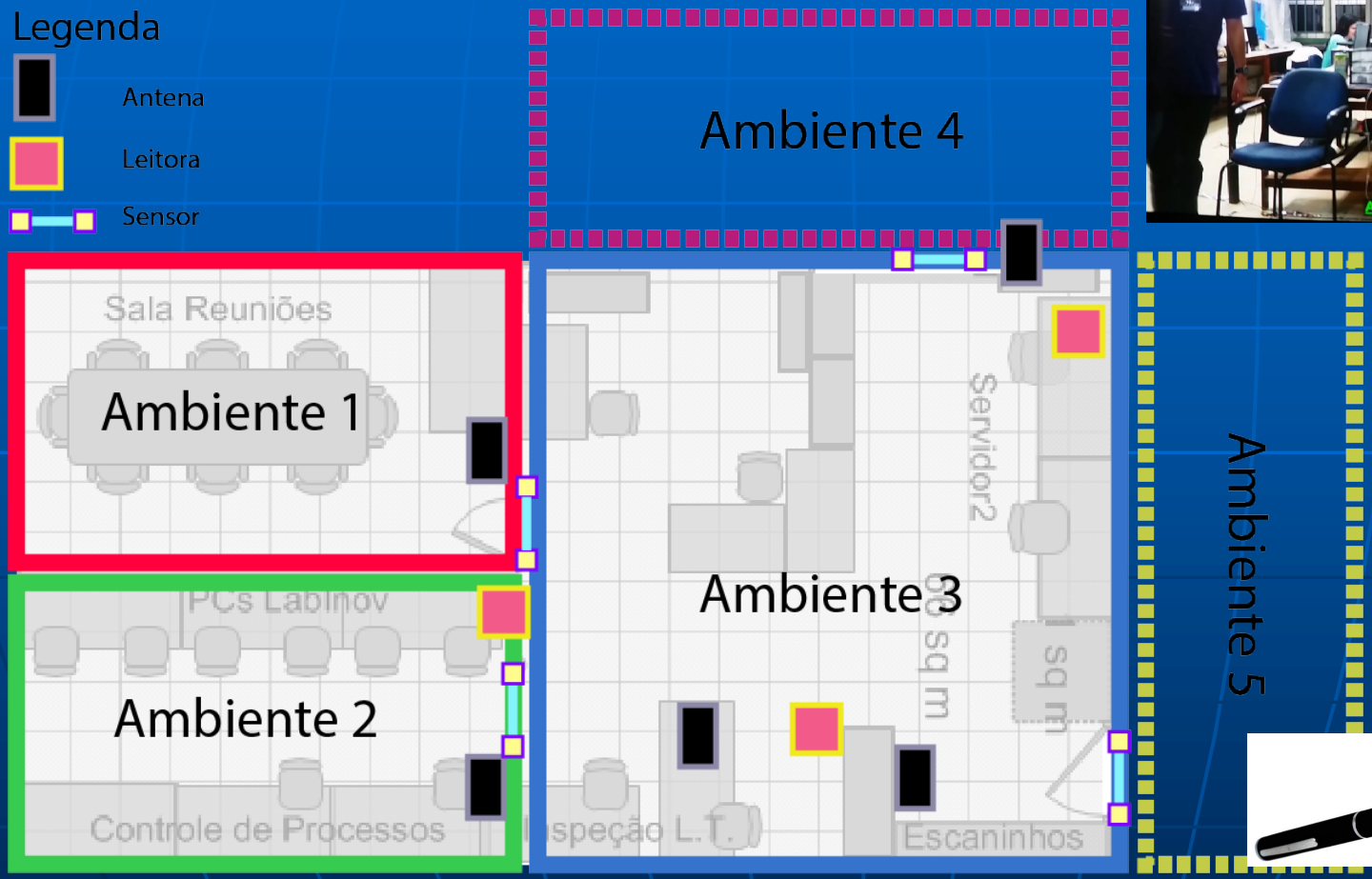
ta colected by mobile robot Aramis





Passive RFID occupancy + Laser

TG2015 Mecatrônica
Renata C.M. Chupel e Raissa A. Alves

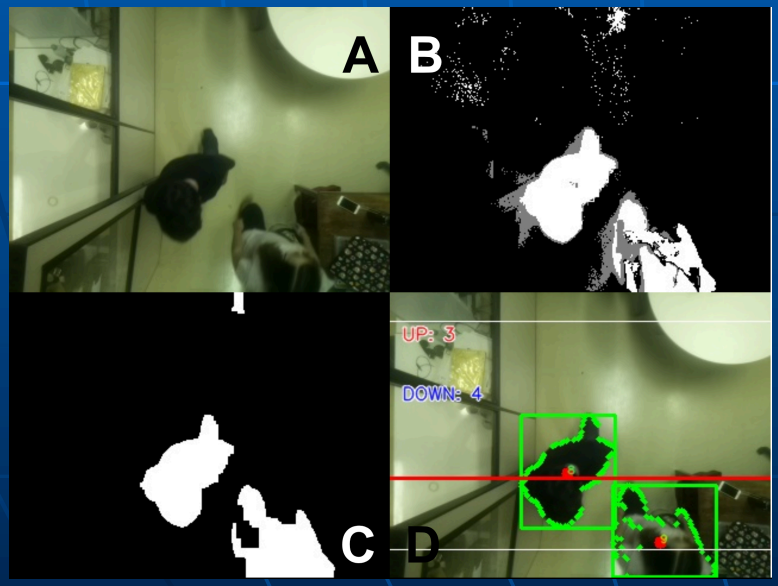


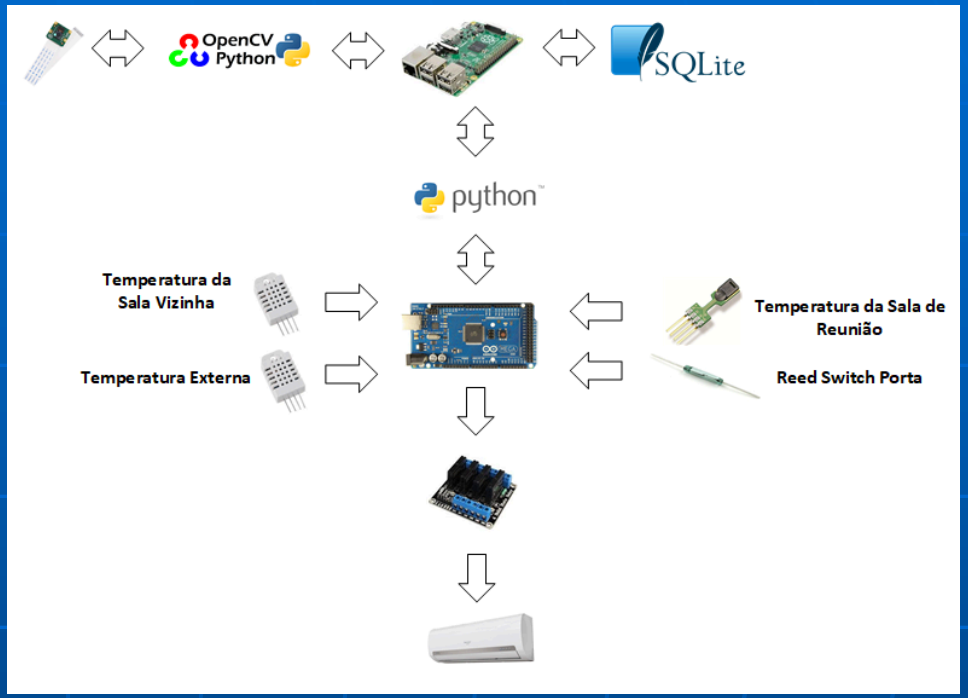
Feedforward Control using Video Thermal Load Estimation

TG2018 Mecatrônica
Mariana Pimentel e Alexandre Saran

1 Person →0,116 kWh

Persons Count

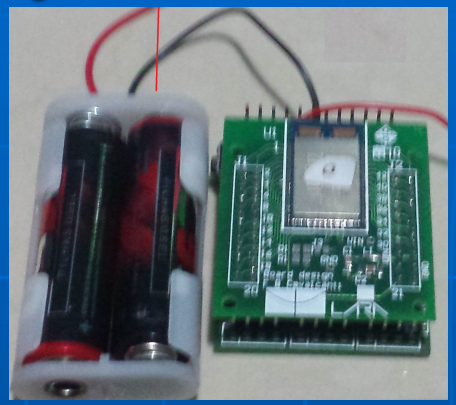




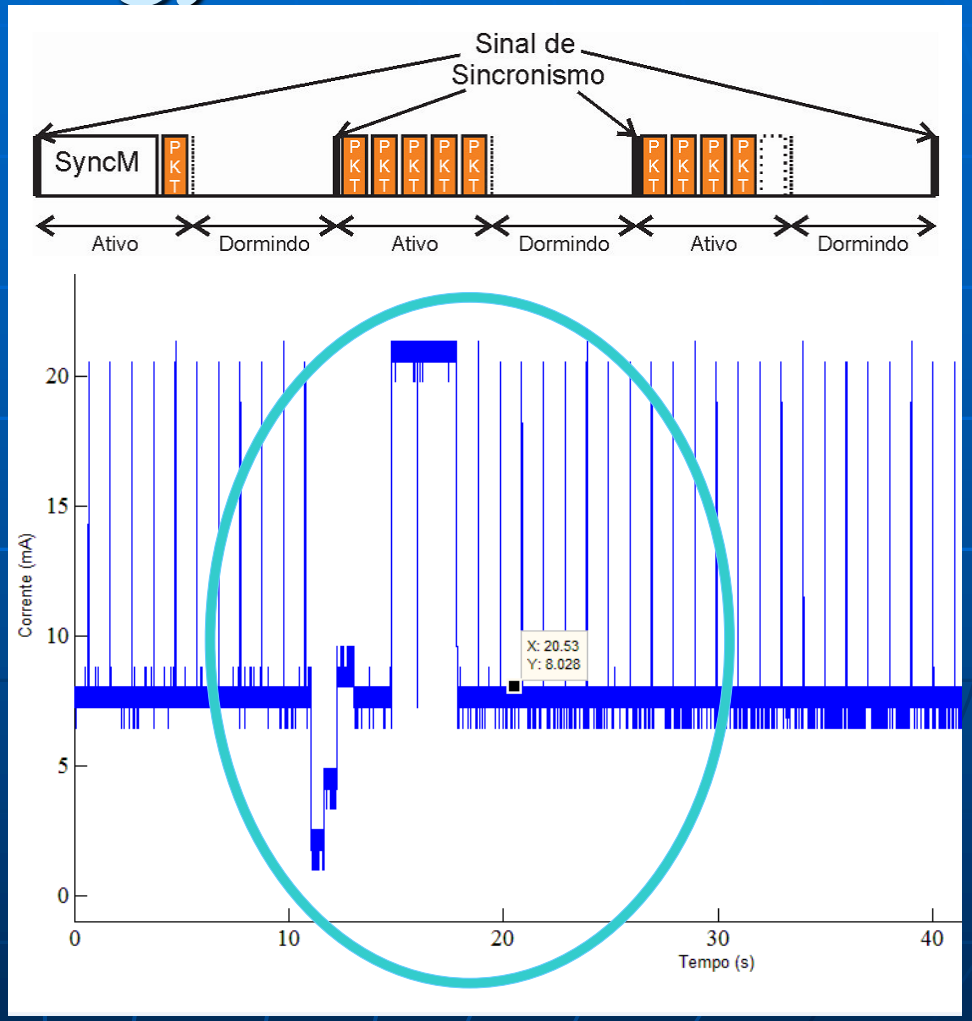
Controller	Energy	RMSE (Comfort)
On/Off	7,92 kWh	0,42
Antecipative	5,81 kWh	0,37
Gain %	26,64%	11,9%

DyTEE MAC/UnB – Dynamic Timed Energy Efficient

MSc Vinícius Guimarães, 2014



Sensor Node

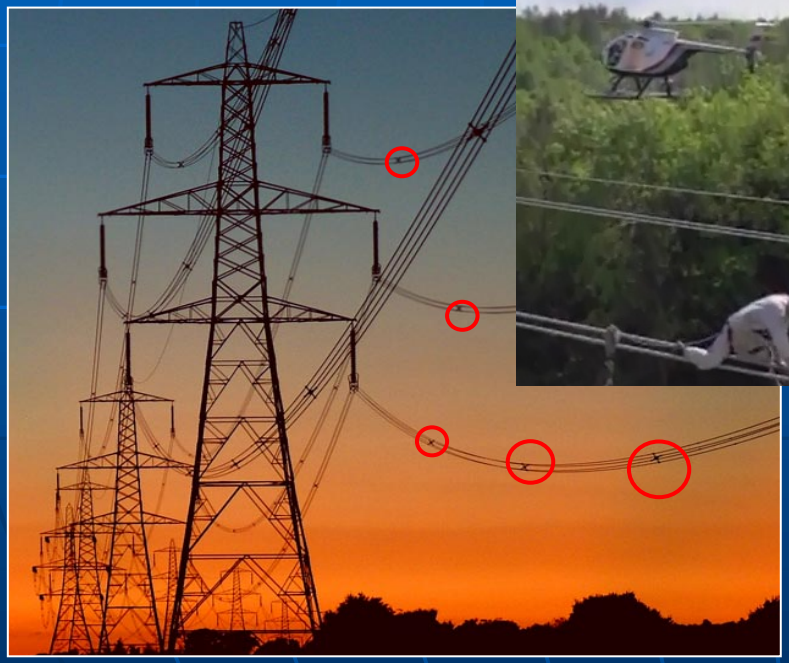


DyTEE

IEEE 802.15.4

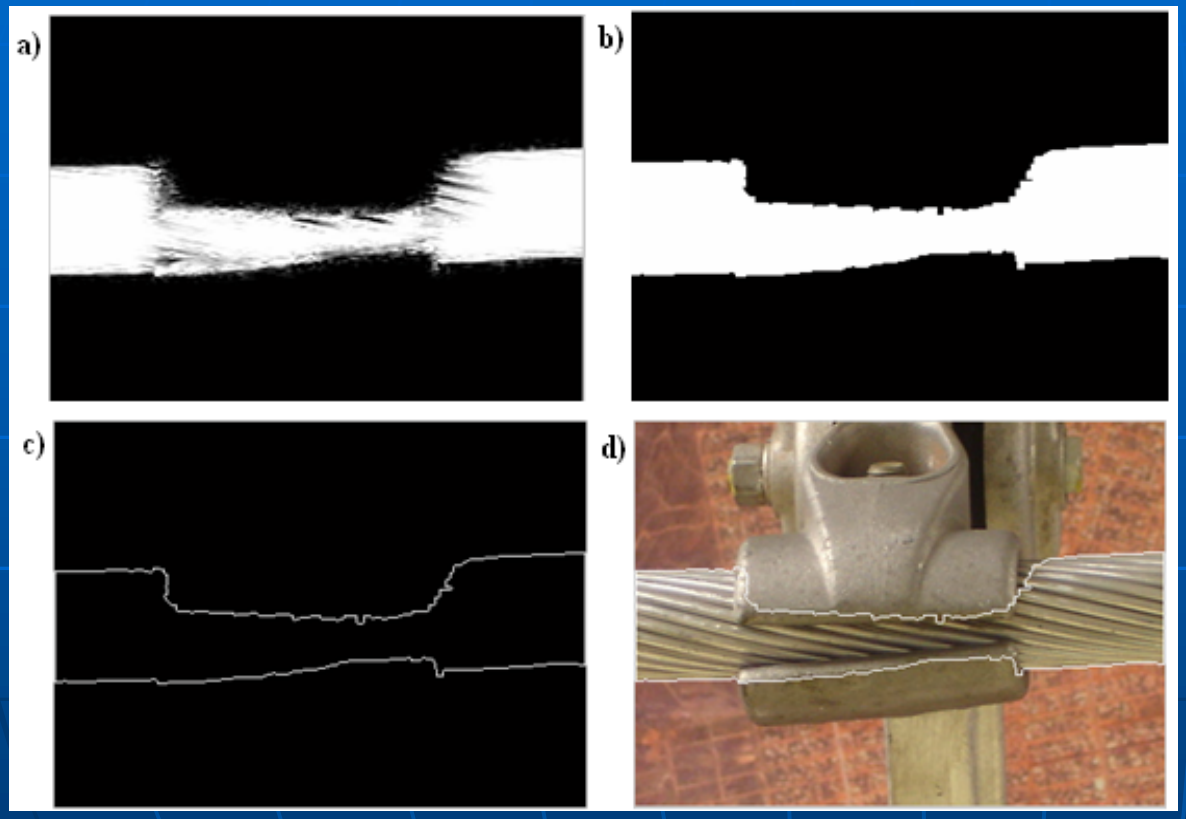
Inspection of Transmission Lines

- Autonomous system - visual inspection of electricity transmission lines
- Detection of flaws in the gripper of the line spacers

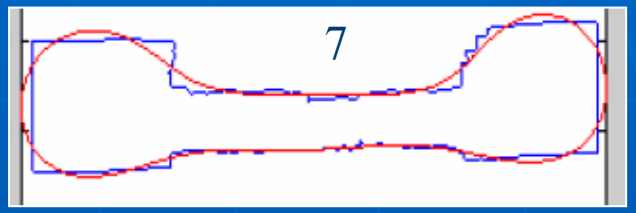


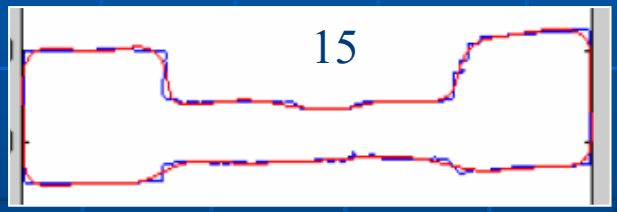
Need Maintenance!!

Gripped cable contour:
FFT coefficients of directional chains



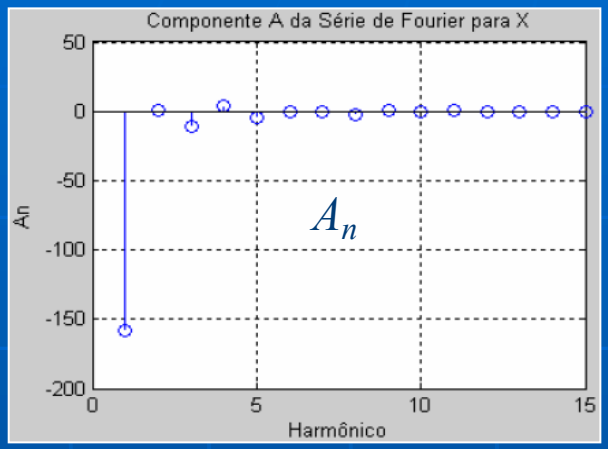
a) Gabor – b) Closing – c) Border – d)Image

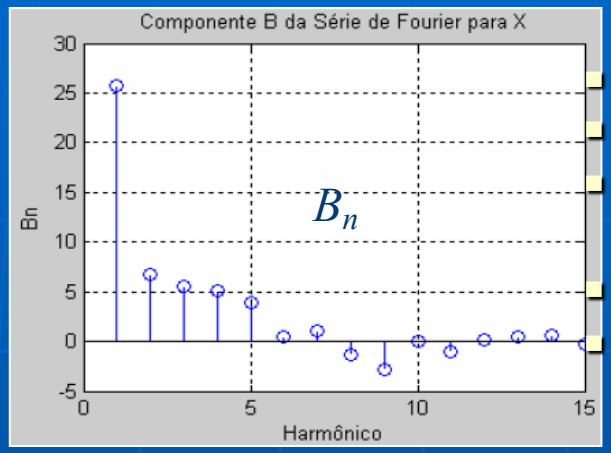


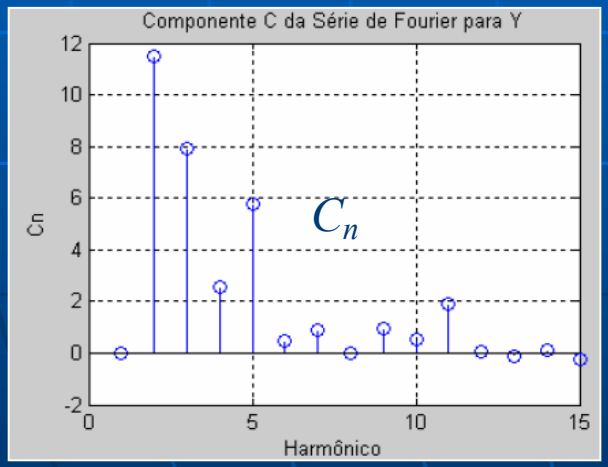


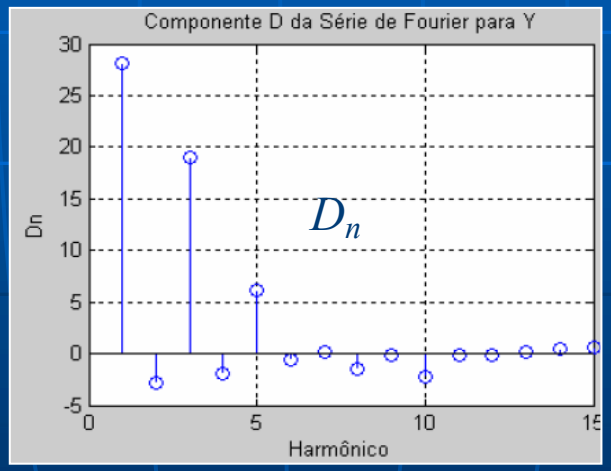
Reconstruction -
7 and 15 Harmonics

Gripped cable contour: FFT coefficients of directional chains



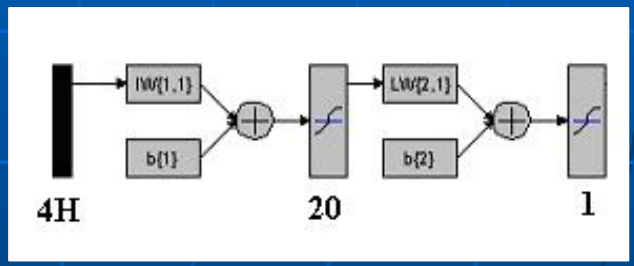






ANN –
"Need Maintenance" classification

Training, Test, Validation
80, 25, 25 images



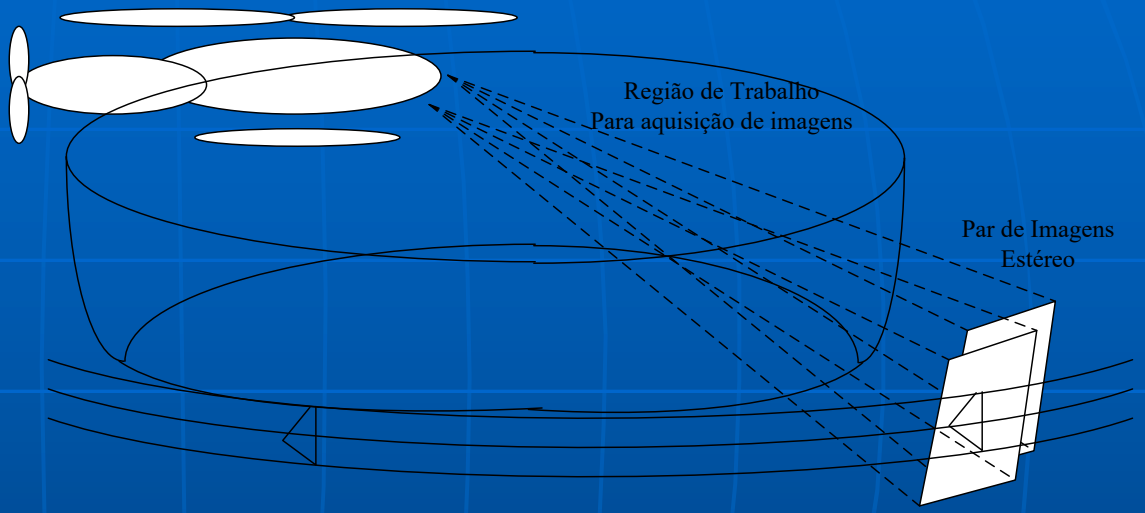
H=10 ➛
2 Misclassified images

H=12 ➛
1 Misclassified image

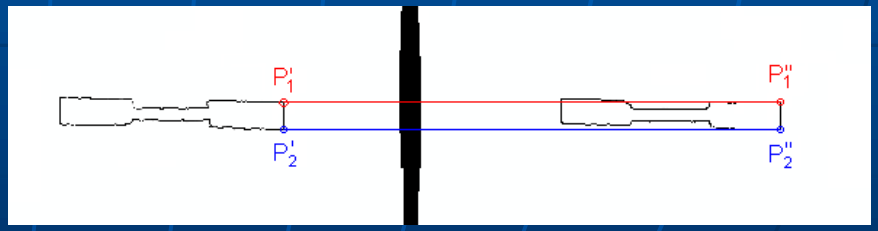
Flávio Oliveira & Alexandre Dias, 2007

Gripper inspection with 3D reconstr.

- It is not possible to train an ANN for every position/orientation in the visual field of the VANT.
- ANN trained for a fixed point of view.
- Build 3D contour model
- Reproject 3D contour to ANN point of view
- Classify with ANN

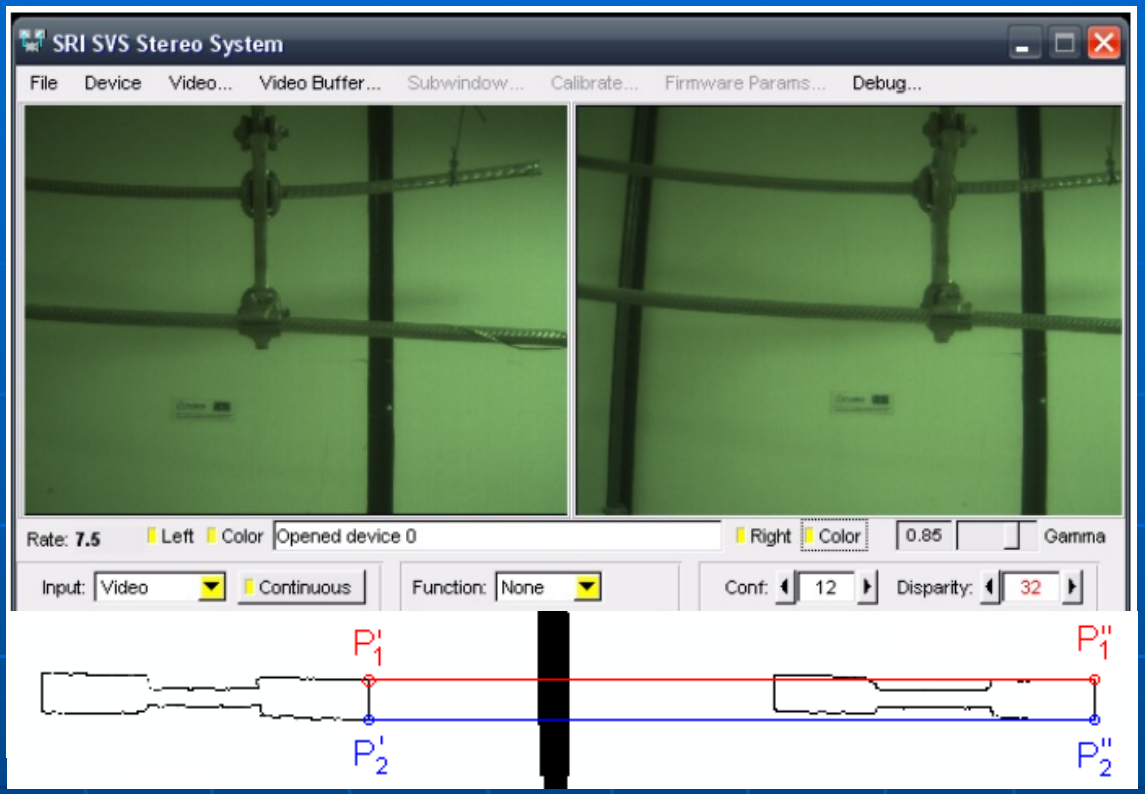


Different ROI's

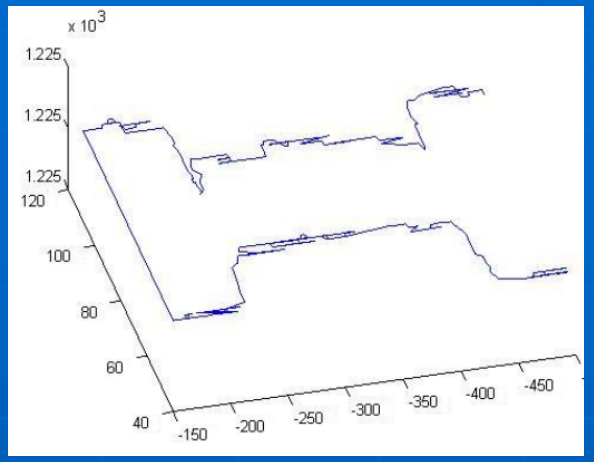


Correspondence –ROI contour in stereo pair

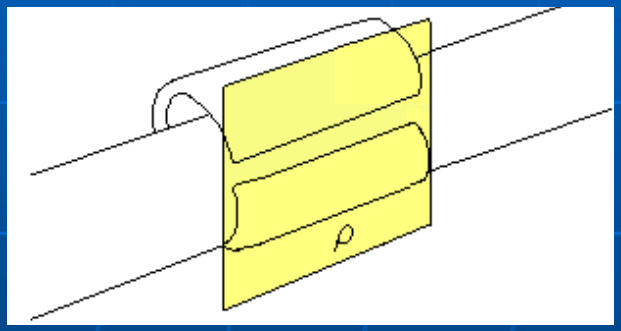
3D gripped cable



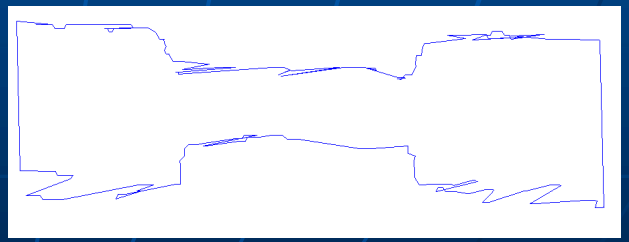
3D Reconstruction



ANN data bank Image plane



Reprojected contour for ANN



Results:
20 stereo pairs – 1 false pos., 1 false neg.
Elder Oroski, 2011

nZEB – FAU/ENM/ENE

Profª. Cláudia Amorim
Prof. João Pimenta
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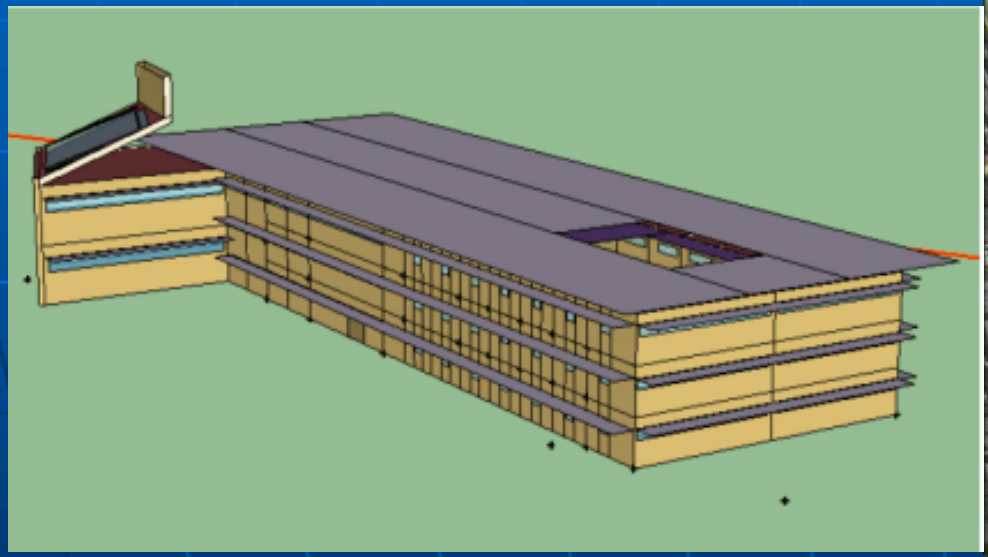
Prof. Adolfo Bauchspiess



Brick, 2014

Coen van Oostrom, CEO Edge Technologies, NL

- Real Estate Company -> Smart, Green Cities
- Inspired by Al Gore
  (35% of carbon emission came from buildings)
  - Businesses not governments, make cities sustainable.

- Build green buildings – not so much difficult.

The Edge, highest BREEAM score (98,4%)!

BREEAM - Building Research Establishment Environmental Assessment Method, UK, 1990

LEED – USA
Procel Edifica - Brazil

MOBILIDADE	URBANISMO	MEIO AMBIENTE	ENERGIA	TECNOLOGIA E INOVAÇÃO	EDUCAÇÃO	SAÚDE	SEGURANÇA	EMPREENDEDORISMO	ECONOMIA	GOVERNANÇA
10 indicadores	12 indicadores	14 indicadores	6 indicadores	10 indicadores	11 indicadores	8 indicadores	6 indicadores	7 indicadores	12 indicadores	14 indicadores

Connected SMART CITIES

Posição 2018	Posição 2017	Município (UF)	Pontos
1º	2º	Curitiba (PR)	31,782
2º	1º	São Paulo (SP)	31,459
3º	5º	Vitória (ES)	31,219
4º	8º	Campinas (SP)	30,920
5º	6º	Florianópolis (SC)	30,881
6º	3º	Rio de Janeiro (RJ)	30,505
7º	4º	Belo Horizonte (MG)	30,069
8º	11º	Porto Alegre (RS)	29,991
9º	12º	Santos (SP)	29,954
10º	18º	Niterói (RJ)	29,884

Thank You!

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