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ISTANBUL 2016

Heat and Mass Transfer Technological Center (CTTC)

Universitat Politècnica de Catalunya-BarcelonaTech (UPC)

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This presentation is for

- ☑ **Workshop 1** Big Data
- ☐ **Workshop 3** Photonics and Micro-and-Nanoelectronics
- ☐ **Workshop 2** Robotics
- ☐ **Workshop 4** internet of Things

Description of the Organization

- CTTC director: Prof. Assensi Oliva
- CTTC research co-director: Prof. Carlos D. Pérez-Segarra
- CTTC promoter: Prof. Joaquim Rigola
- CTTC personel: 50 persons full time (30 Ph. D. students)
- More than 100 international journal papers in last 10 years
- **More than 60 research projects with companies, and within national and EU frameworks in last 10 years**

Mathematical formulation, numerical resolution and experimental validation of heat and mass transfer phenomena.

- Natural and forced convection
- Turbulence simulation (RANS, LES, DNS)
- Combustion
- Two-phase flow (VOF, two fluid models)
- Solid-liquid phase change (PCM materials)
- Radiation (surface and participating media)
- Porous media
- Computational Fluid Dynamics and Heat Transfer (CFD&HT)
- Compressible effect and noise evaluation
- Computational Structure Dynamics (CSD) and Fluid Structure Interaction (FSI)
- Aerodynamics
- High performance computing: Numerical algorithms and solvers, parallel computing, etc.

Thermal and fluid dynamic optimization of thermal systems and equipments. Application of the acquired know-how from the basic studies

- Refrigeration (vapour compression cycles, absorption refrigerating systems, compressors, expansion devices, etc.).
- HVAC (ventilation, diffusion of contaminants in buildings,...).
- Active and passive solar systems (solar collectors using transparent insulation materials, building facades with transparent layers and ventilation, etc.).
- Concentrated Solar Plants (CSP) (solar tower, storage tanks, etc.)
- Wind Energy (blade design, thermal nacelle, wind farms, etc.)
- Heat exchangers (single – phase and two – phase heat exchangers, combustion heaters,…).
- Heat storage by liquids and using phase change materials.
- Engine cooling and air conditioning in the automobile and the aeronautical fields.
- Aerodynamics, etc..

Previous EU project experiences

FP7-2013-NMP-ENV-EeB (2013-2017)(8.800.000,00€)

REtrofitting Solutions and Services for the enhancement of Energy Efficiency in Public Edification (RESSEEPE)

Previous EU project experiences

TECHNOLOGIES

- Isolation strategies for energy conservation
  - ***Aerogel-based superinsulating mortars***
  - ***VIP panels***
- Solar strategies for energy and heat recovery
  - EC windows
  - ***PV panels coupled with ventilated façades***
  - ***High efficiency flat plate solar collectors***
- Strategies for thermal energy storage
  - ***Latent heat thermal energy storage***
  - ***Sensible heat thermal energy storage***
  - Seasonal thermal energy storage
- Lighting strategies based on LED solutions
- Strategies for efficient HVAC systems
  - Dimensioning and control strategies
  - Predictive models
- Combining technologies

Coventry University George Eliot Building (Coventry, UK)

Balderskolan (Skellefteä, Sweden)

Hospital de Terrassa (CSPT)

Hospital de Sabadell (Parc Taulí)

Previous EU project experiences

KIC Innoenergy Project

Intelligent Energy Efficient Buildings and Cities

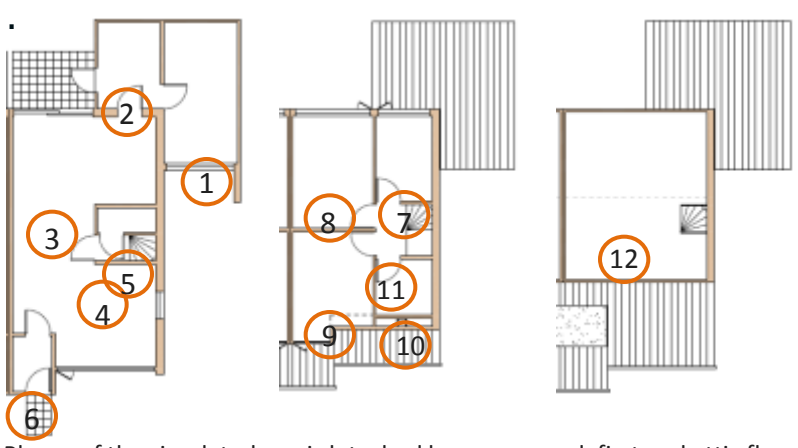
Dwelling Climate Control Systems (DCCS)

Centre Tecnològic de Transferència de Calor
UNIVERSITAT POLITÈCNICA DE CATALUNYA

Previous EU project experiences

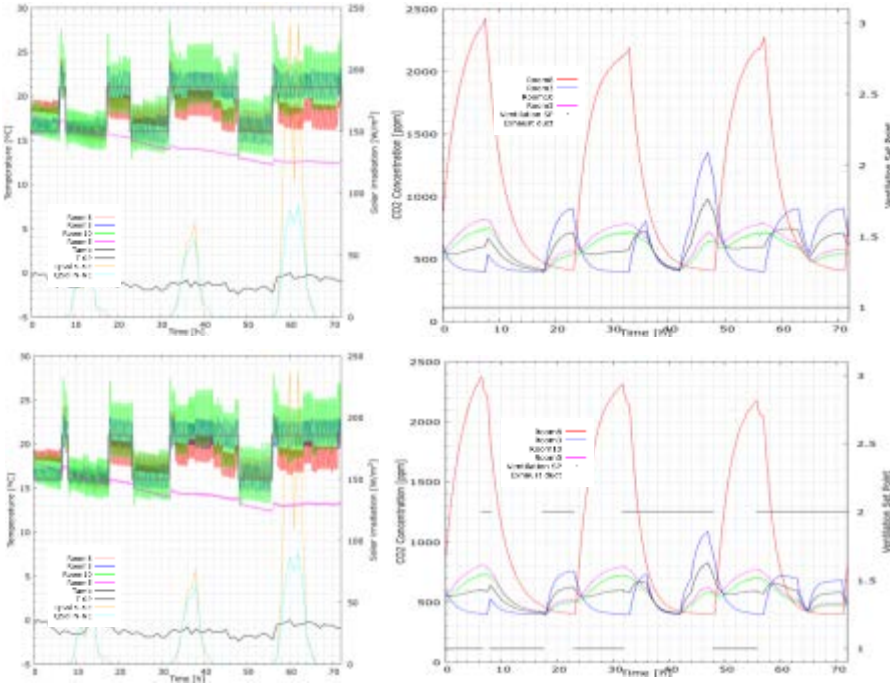
UPC software: NEST-Buildings

- **In-house modular** code (programmed in C++) → a **building** is modelled as a **collection** of **basic elements** (walls, outdoor, solar and thermal radiation elements, rooms, openings, radiators, TRV, boiler, etc.)
- **Different models** (lumped volumes, 1D, CFD&HT…).
- Calculations can be done in several **parallel** processes
- Elements which are capable of solving themselves for given boundary conditions → **Flexibility**.
- Occupancy events.
- Humidity, CO2, VOC.



Planes of the simulated semi-detached house: ground, first and attic floors

Development of a **simulation test bench**: **detailed model** of a **single-family dwelling** (a semi-detached house located in Netherlands). This off line testing permits to **test the control algorithms**. It enables to calculate the **comfort** and **energetic effects** of the control units in the house.



The thermo-fluidic simulation under three control strategies. (Left) Thermal performance of different rooms. (Right) [CO_2] of different rooms and at exhaust duct, and ventilation setpoint.

List of Relevant projects

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Top 10 CTTC-UPC research projects within last 5 years

1. Research Project **ENE2014-60577-R**; MEC (Spanish Government); Funding: 100.000 Euros; Title: Development of high-performance parallel codes and algorithms for the improvement of the efficiency applied to wind-energy, solar thermal and building; Period: 2015 – 2017.
2. Research Project **H2020-686783 Cleansky2**: Funding: 323.812 Euros, Title: MALET Development of MODELICA Libraries for ECS Thermal management architectures, Period: 2015-2017.
3. Research project ref. C-10104; Company: **Huangshi Dongbei Electrical Appliance Co, Ltd.**; Funding: 180,000 euros; Title: Technology Development Cooperation Agreement for LC Series, Period: 2014-2015.
4. Research project ref. ID-620129 (SP1-JTI-CS-2013-01 **Cleansky**; Funding: 180,987 euros**;** Title: EFFAN – Efficient Fan, Period: 2014-2015.
5. Research project, ref. **FP7- EeB.NMP.2013-3**, E01199; Title: RESEEPE Retrofitting solutions and services for the enhancement of energy efficiency in public edification; Funding: 368.871 Euros**;** Period 2013-2015.
6. Research project Q-00023; Company: **EIT-KIC InnoEnergy project**; Title: Thermal storage for concentrating solar power plants; Funding: 650000 Euros; Period: 2011-2014.
7. Research project C-08632; Company: **Anortec, S.L**.; Title: Research and development for the aerodynamic design of the blades of aerogenerators; Period: 2011-2012.
8. Research project Q-00011; Company: **EIT-KIC InnoEnergy project**; Title: Energy storage as necessary part of energy balanced building and districts; Period: 2011-2014.
9. Research Project E01053, ref. 218849, **ISP-1; European Commission**, Directorate-General XII; Companies: Snecma, Astrium, AVIO, Mikroma, Alcimed, Bonatre; Funding 206250 Euros; Title: In Space Propulsion 1; Period:2009-2012.
10. Research Project, ref. C07564; Company**: Abengoa Solar New Technologies**; Title: Project “ConSOLI+Da” Consorcio Solar de Investigación y Desarollo; Subject: Vapour receivers for solar tower power plants; Funding 500000 Euros; Period:2008-2011.

High performance and parallel computation expertise adapted to different applications

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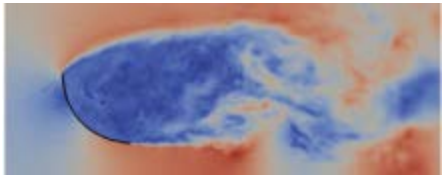
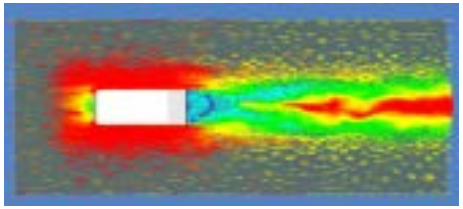
CTTC-UPC High Performance Cluster (HPC – JFF)

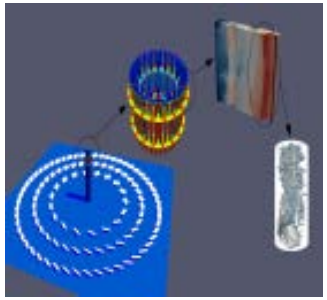
- Beowulf HPC cluster.
- Infiniband DDR 4X network interconnection between nodes with latencies of 2.25 microseconds with a 20Gbits/s bandwith.
- The system of files allow unified capacities of several Petabytes highly scalable.
- 128 nodes, each node has two Quad-core CPUs, total of 1024 processing cores.
- 40 nodes, each node has 32 Cores, total of 1280 processing cores.

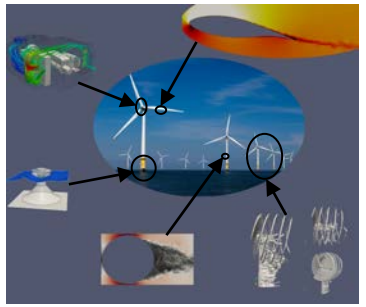
Computational Fluid Dynamics and Heat Transfer (CFD&HT): TermoFluids code

- 3D parallel unstructured code
- DNS, RANS and LES turbulence models
- Dynamic mesh methods for CSD and FSI
- Radiations, combustion
- Multi phase phenomena
- Multi physics modelling

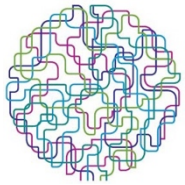








Relevant 2017 Call Topics for CTTC



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CTTC can offer expertise in the following calls:

•ICT-15-2016-2017 **Big Data PPP: Large Scale Pilot actions in sectors best benefitting from data-driven innovation**
•ICT-17-2016-2017 **Big data PPP: Support, industrial skills, benchmarking and evaluation**
•ICT-30-2017 **Photonics KET 2017**
•ICT-05-2017 **Customised and low energy computing (including Low power processor technologies)**

- Group with **broad experience in EU projects** as added-value partner
- **Experience in coordinating** EU projects

Consortium - profile of known partners
TermoFluids S.L.

TermoFluids, S.L., **a spin-off company** formed by the researchers of CTTC with similar capabilities, hoping to collaborate in projects where **SME participation** is required.

HT&CFD – HPC – Multi-scale – Multi-physics– High Efficiency Systems

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THANK YOU FOR YOUR ATTENTION !