Politecnico di Torino
Dipartimento di Automatica e Informatica

PhD in Computer and Control Engineering
XXXV cycle

Supervisor
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Study and implementation of compact modeling techniques for the energy analysis and optimization of complex systems

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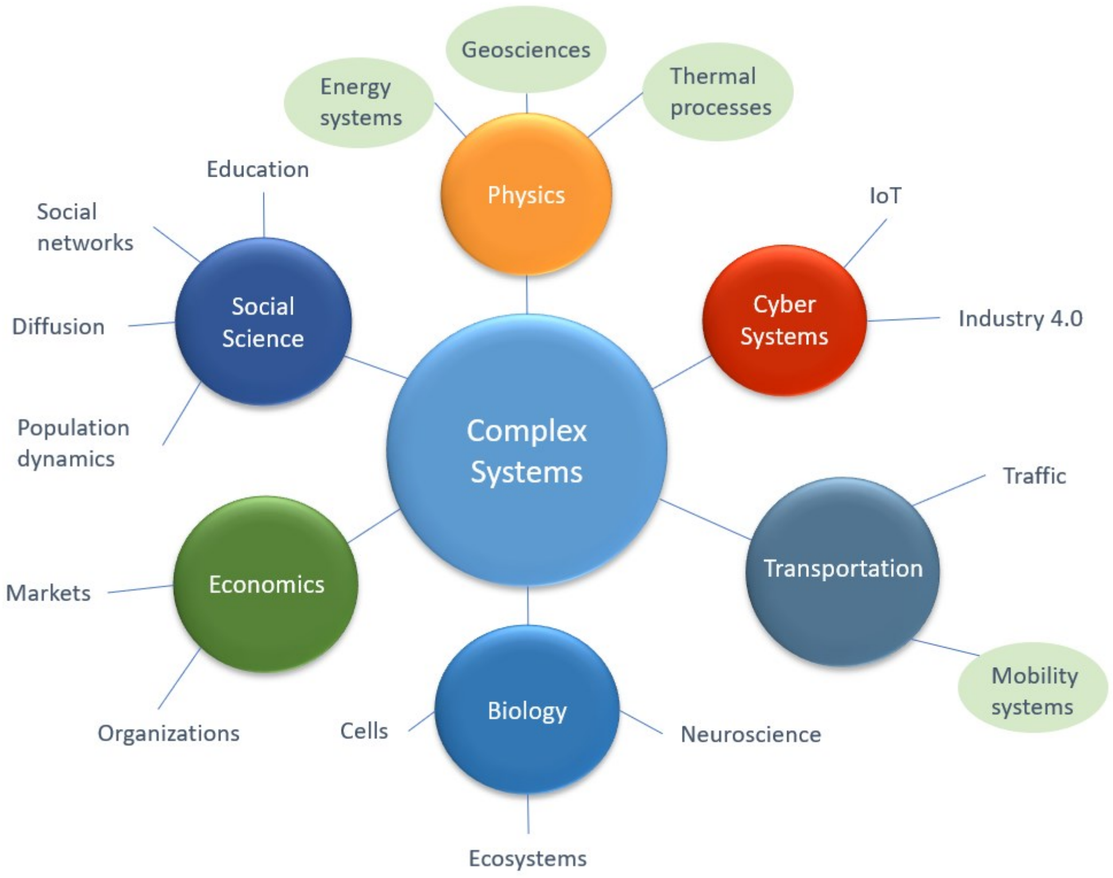
1. Context

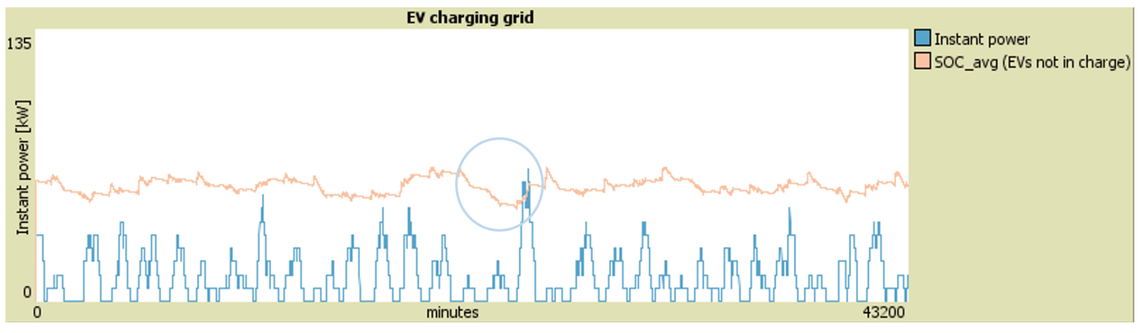


2. Goal / Objectives

The aim of this program is the definition of a method to generate simpler models of complex systems that can be directly used by most users for the energy analysis and optimization of such systems.

3. Research activities

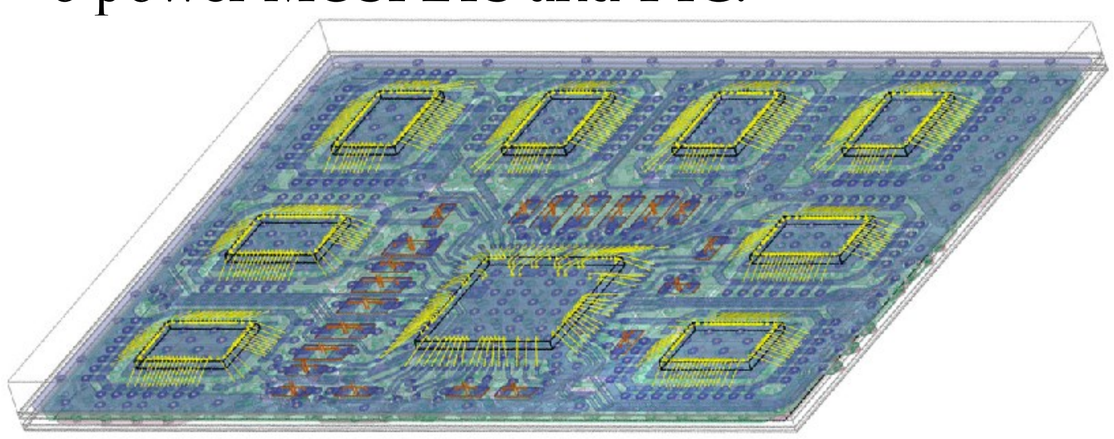
- Improving existing models in the area concerned
- Proposing new models
- Adopting and/or adapting models of a different area
- Holistic approach to data analysis
- Mathematical and computational models
- Empirical methods (e.g., regression)



4. Results

Thermal analysis of a BGA SiP

8 power MOSFETS and 1 IC:



$$T_{max} = T_{ref} + T_0 \cdot \left(\frac{I_p}{I_0}\right)^{w_1} \cdot e^{(I_p/w_2)} \qquad [^\circ C]$$

Energy storage systems

Adapting the Peukert equation to batteries discharged at pulse currents:

$$t_s = \frac{C_{ref_x}}{{I_x}^{k_x}}$$

Yearly solar irradiation [kWh/m²]

Analysis in Europe and Africa:

$$H_y = a_1 + \frac{a_2}{T_m} + a_3 \cdot \mid \phi \mid \cdot T_m^2 + a_4 \cdot \phi^2$$

5. References

1. A. Bocca, A. Macii, and E. Macii, "Forecasting the grid power demand of charging stations from EV drivers' attitude," *2021 IEEE 45th Annual Computers, Software, and Applications Conference (COMPSAC)*, 12-16 July 2021, online event, pp. 1867-1872.
2. A. Bocca and A. Macii, "Thermal modeling and analysis of a power ball grid array in system-in-package technology," *Multiscale and Multidisciplinary Modeling, Experiments and Design*, vol. *5* n. *1*, pp. 31-41. Springer Nature, 2022.
3. A. Bocca, Y. Chen, A. Macii, E. Macii, and M. Poncino, "Adapting the Peukert equation to batteries discharged at pulse currents," *2022 International Symposium on Power Electronics, Electrical Drives, Automation and Motion (SPEEDAM)*, 22-24 June 2022, Sorrento, Italy, pp. 64-69.
4. A. Bocca, A. Macii, and E. Macii, "A nonlinear two-parameter model for the spatial analysis of solar irradiation," *2022 IEEE 46th Annual Computers, Software, and Applications Conference (COMPSAC)*, 27 June - 1 July 2022, online event, pp. 1362-1367.