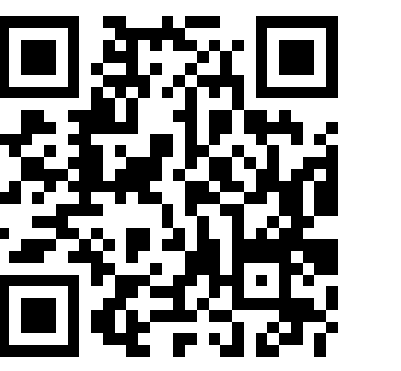




# (0384) Distributed optimization in energy communities: a focus on flexibility provision



iahl.github.io

Esteban González Iaki  
CITCEA UPC  
Spain

Oriol Gomis-Bellmunt  
CITCEA UPC  
Spain

Eduardo Prieto-Araujo  
CITCEA UPC  
Spain

Paula Muñoz-Peña  
CITCEA UPC  
Spain

Aleix Señís  
Schneider Electric  
Spain

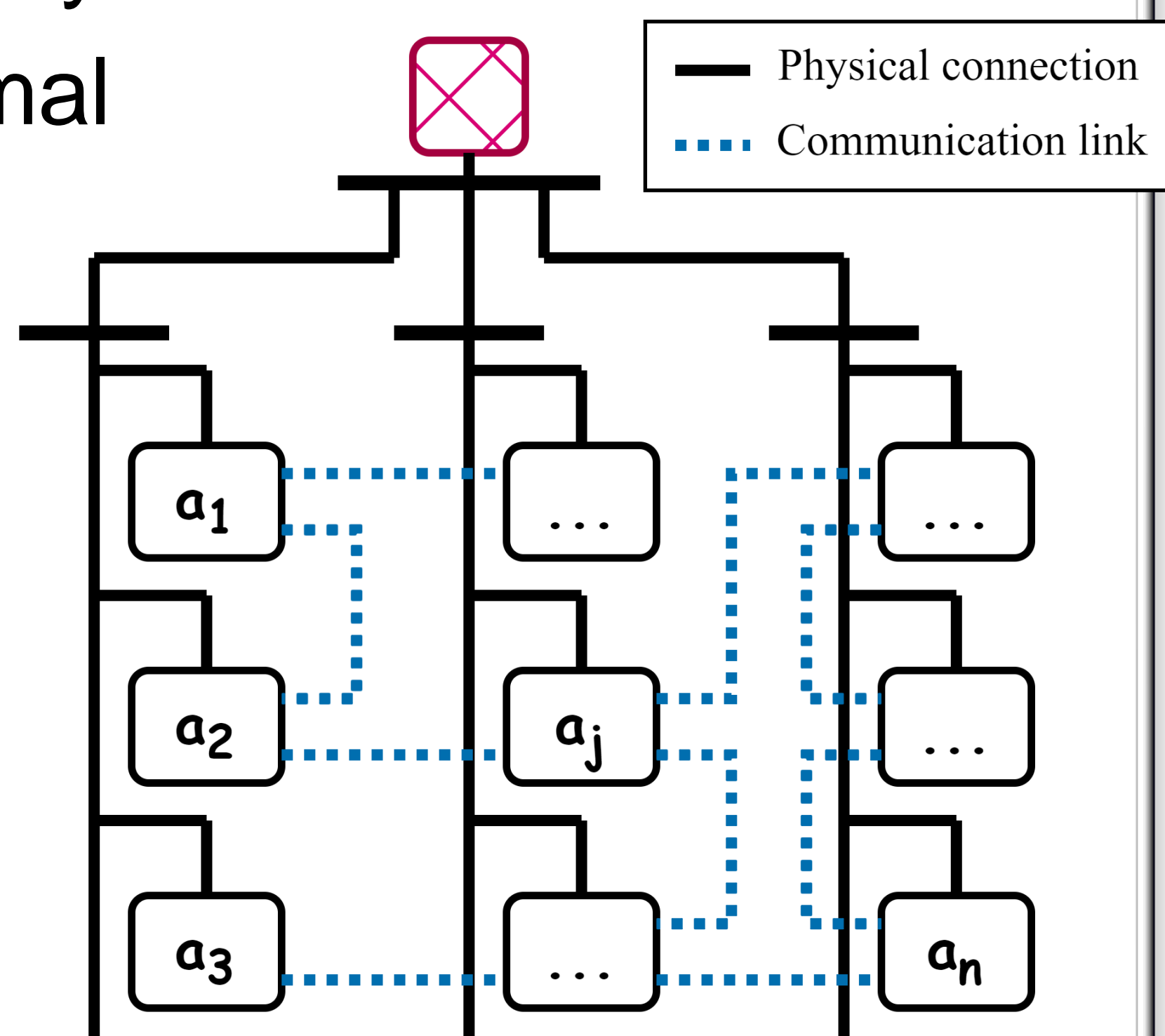
Marina Fajardo  
Schneider Electric  
Spain

## Introduction

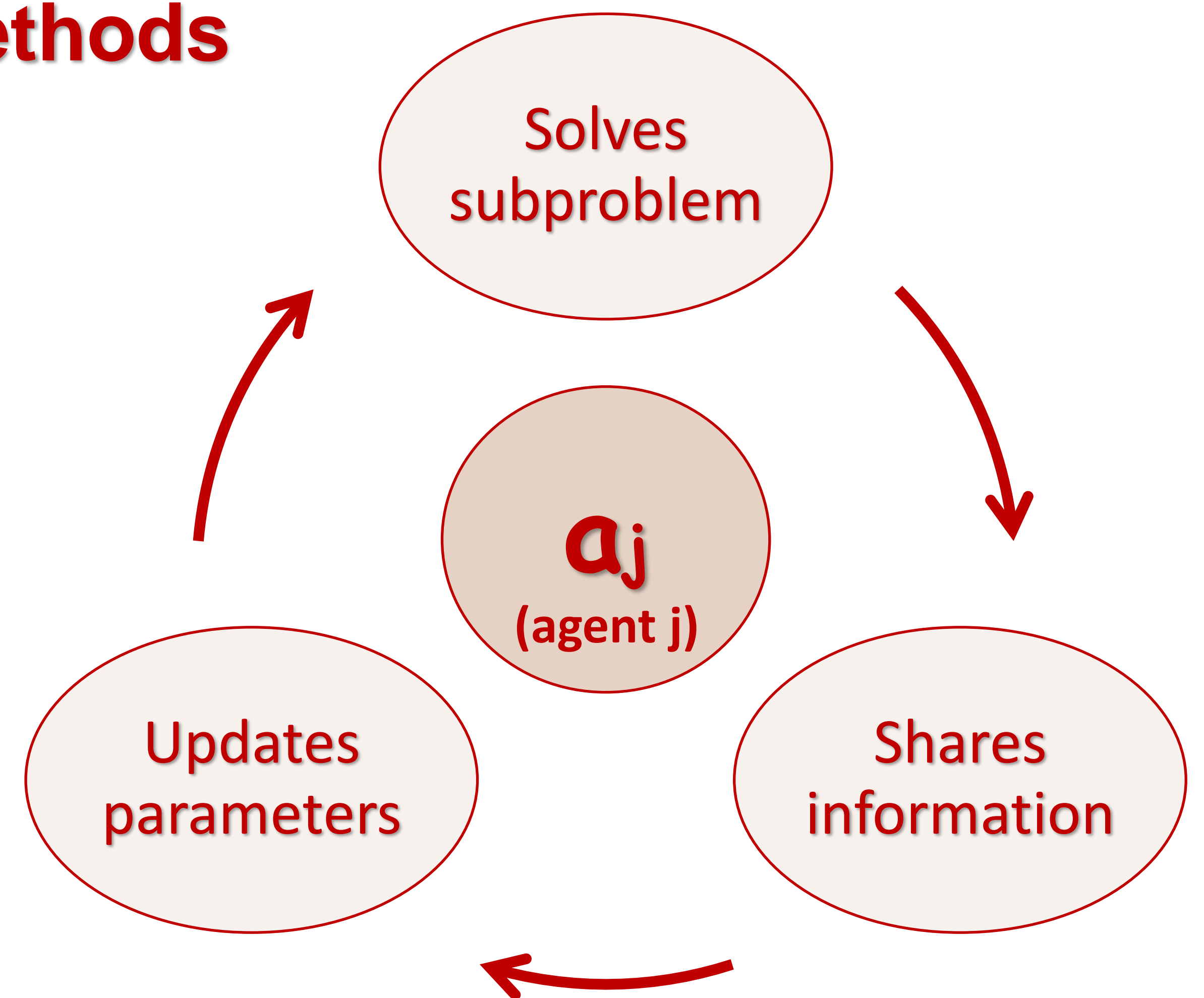
In this work, we propose a **distributed optimization algorithm** to manage the energy consumption of a **multi-agent network** (energy community) that owns a microgrid, addressing key aspects such as:

- ✓ Achieving optimal operational costs
- ✓ No need for a central controller
- ✓ Ensuring the protection of sensitive data
- ✓ Enabling flexibility services
- ✓ Requiring minimal communication infrastructure

$$\mathcal{L} = \sum_{i=1}^n f_i + \sum_{i=1}^n \sum_{j \in \Omega_i} \left( \nu_{ij}^T (\mathbf{p}_i^p - \mathbf{p}_j^p) + \frac{\gamma}{2} \|\mathbf{p}_i^p - \mathbf{p}_j^p\|_2^2 \right) + \sum_{i=1}^n \sum_{j \in \Omega_i} \left( \lambda_{ij}^T (\mathbf{p}_{ij} + \mathbf{p}_{ji}) + \frac{\gamma}{2} \|\mathbf{p}_{ij} + \mathbf{p}_{ji}\|_2^2 \right)$$



## Methods



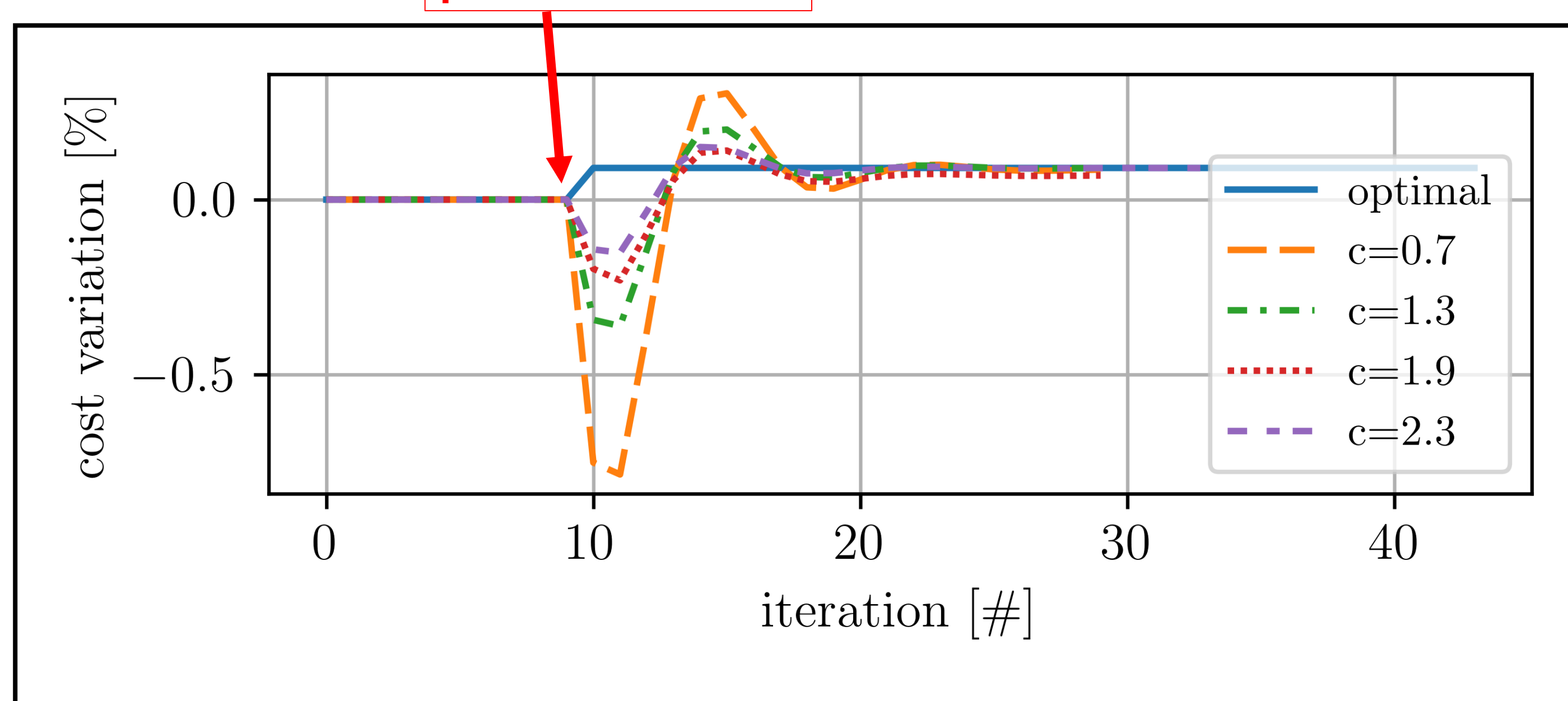
**Subproblem: Economic Dispatch** formulation over a planning horizon, decomposed through the **Auxiliary Problem Principle** technique.

**Information Shared:** The amount of **power virtually exchanged** with each neighbor and the **power purchased** from the utility grid.

**Parameters Updated:** Subproblem **dual variables** and neighbors **shared information**.

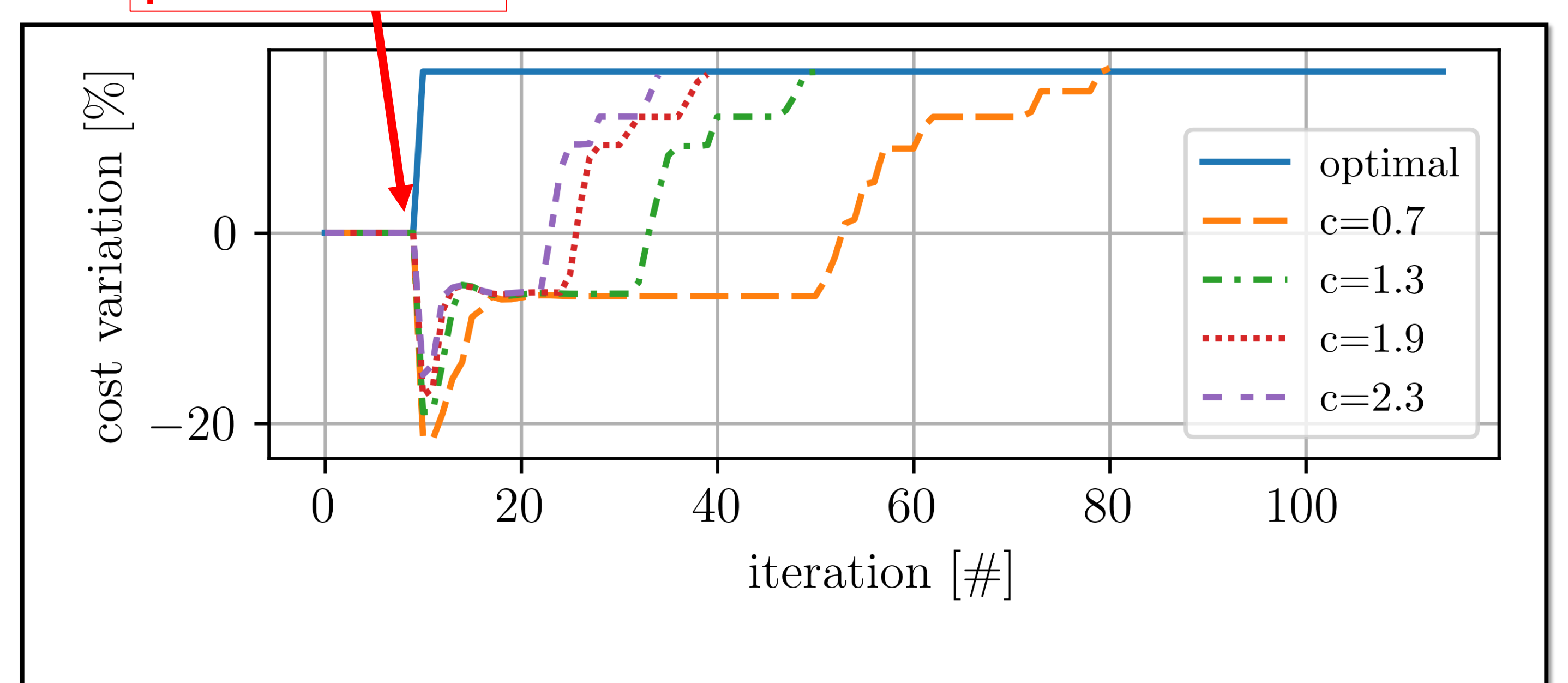
## Results

perturbation



(a) Normal Environmental Fluctuations

perturbation



(b) Scheduled Flexibility Request

## Conclusion

- ❖ There is ample room for the selection of the tuning parameters.
- ❖ The convergence properties remain stable after perturbations.

- ❖ Further research is needed for virtual energy communities (through public infrastructure).
- ❖ Parallel computation and simulation of communication delays would contribute to the evaluation of the speed of the algorithm.

contact: esteban.gonzalez@upc.edu