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

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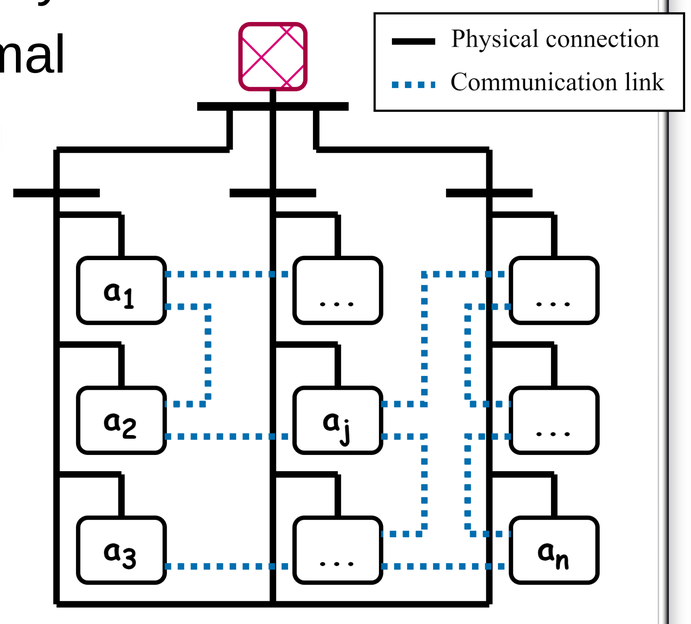
Introduction

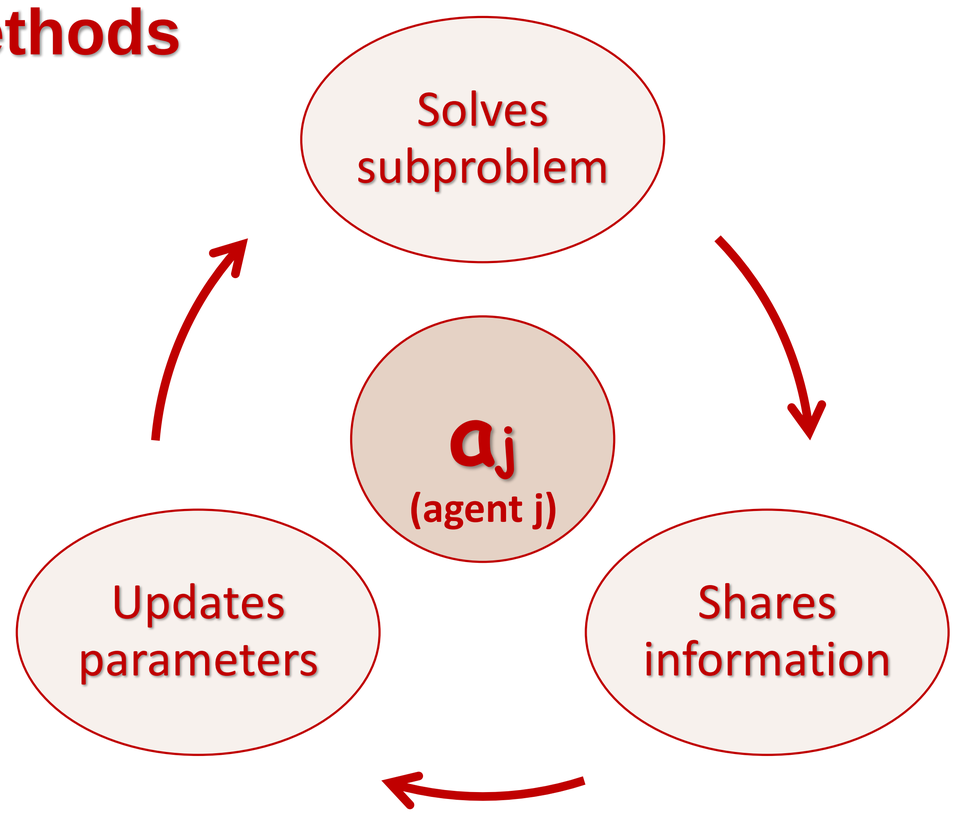
In this work, we propose a **distributed optimization algorithm** to manage the energy consumption of a **multi-agent network** (energy community) that owns a microgrid, addressing key aspects such as:

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



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

Methods

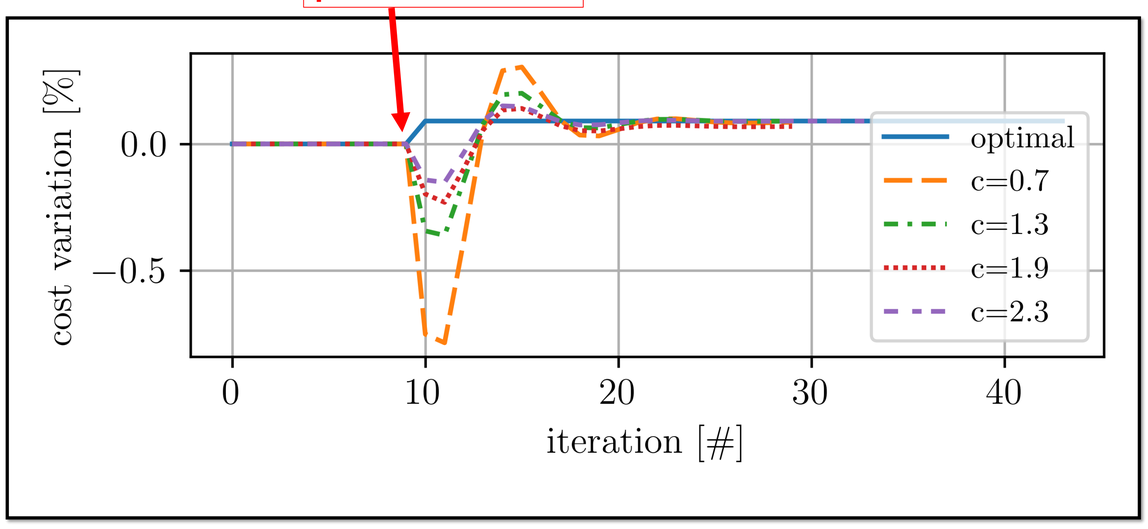


Subproblem: Economic Dispatch formulation over a planning horizon, decomposed through the **Auxiliary Problem Principle** technique.

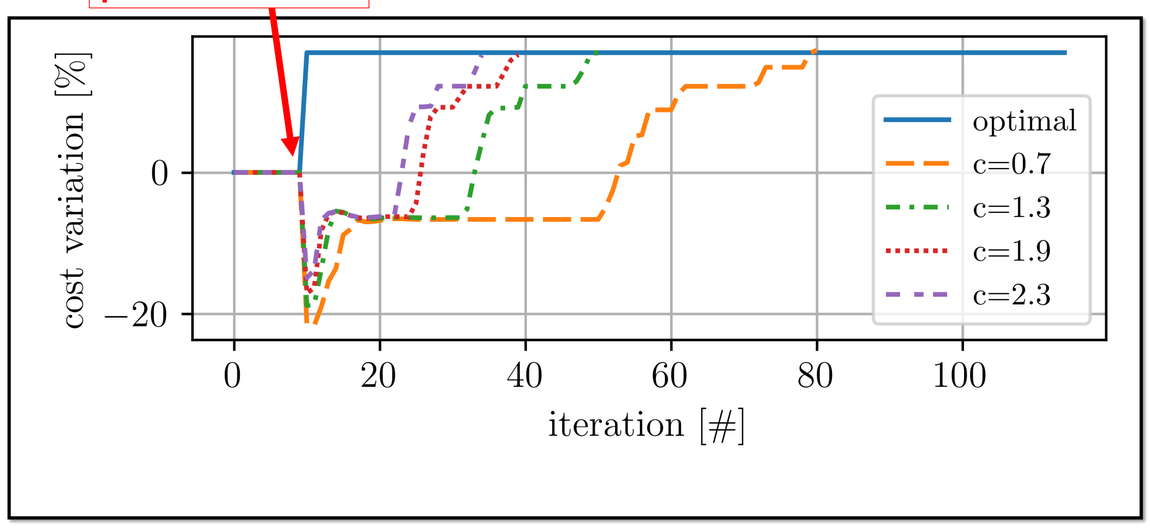
Information Shared: The amount of **power virtually exchanged** with each neighbor and the **power purchased** from the utility grid.

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

Results



(a) Normal Environmental Fluctuations



(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.

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