An Iterative Approach to Finding Global Solutions of AC Optimal Power Flow Problems

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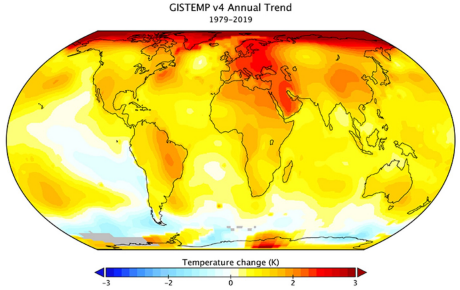
BE BOUNDLESS

Climate Change and Cleaner Energy Systems

Conventional Generators



Global warming

Renewable energy

Power system

Resource allocation algorithm

- Match demand
- Lowest generation cost
- Lowest CO_2 emissions

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Resource Allocation: AC Optimal Power Flow

Optimization problem

min Cost$(P_1, \ldots, P_n)$

s.t. Supply-demand balance constraint $\Leftrightarrow$ λ : Lagrange multiplier

Units and system physical constraints

- Non-convex, hard problem (multiple local solutions)
- Challenges: Randomness in renewable energy resources, need to deal with lots of scenarios, get stuck at sub-optimal solutions
- Open Question: Escape from attraction of local solutions

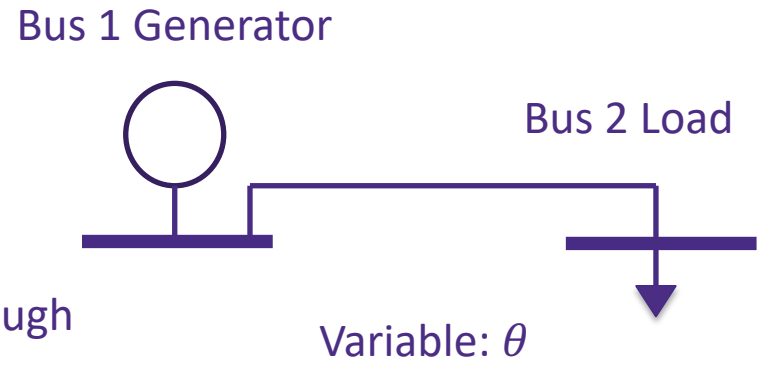
A Two Bus Network Example

- **Transformed to unconstrained form**
- The penalized form

  min Cost$(P_1, \dots, P_n)$+$\rho/_2$ (constraint)^2

  ρ: Penalty parameter

  Equivalent to original problem with ρ large enough



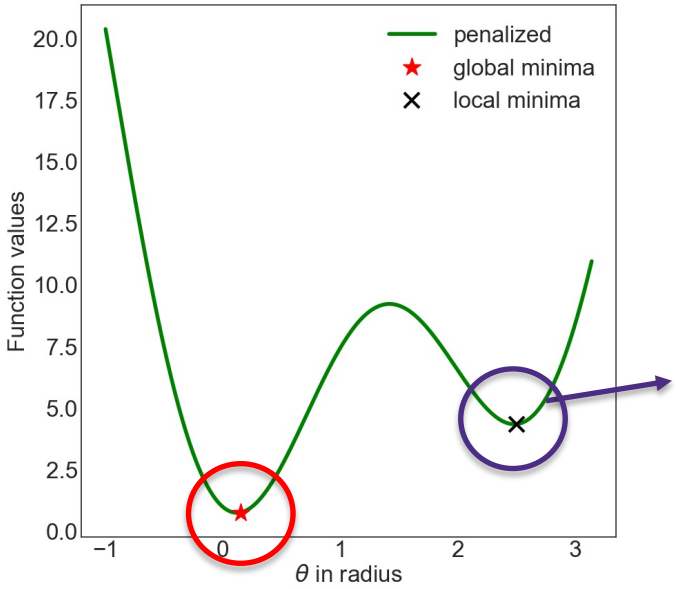
- The Lagrangian

  min Cost$(P_1, \dots, P_n)$+λ(constraint)

  λ: Lagrange multiplier related to the supply-demand balance constraint

A Two Bus Network Example

- **Use the penalized form to study the solutions to ACOPF**

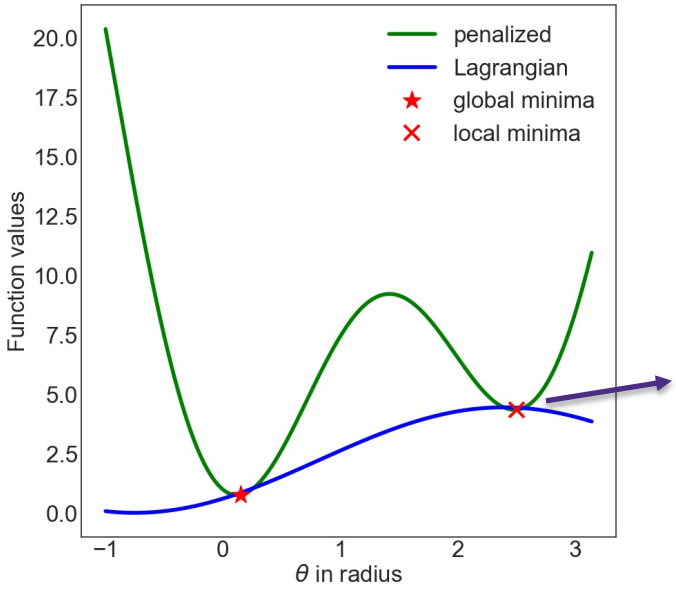


How to escape from local solutions without trying many initialization?

A nonlinear solver initialized at this local solution can get stuck.

A Two Bus Network Example

- **Use the penalized form to study solutions to ACOPF**



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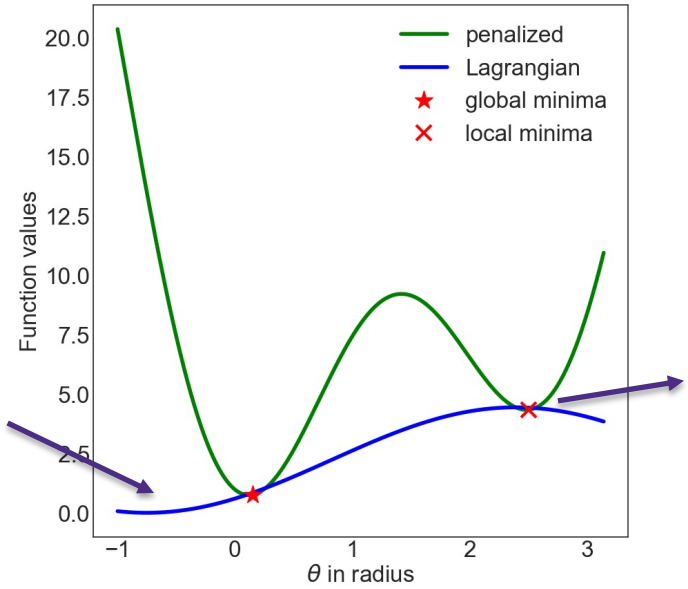
A Two Bus Network Example

- **Use the penalized form to study solutions to ACOPF**

The minimizer of the Lagrangian is close to the global solution.

Can be a good warm start.



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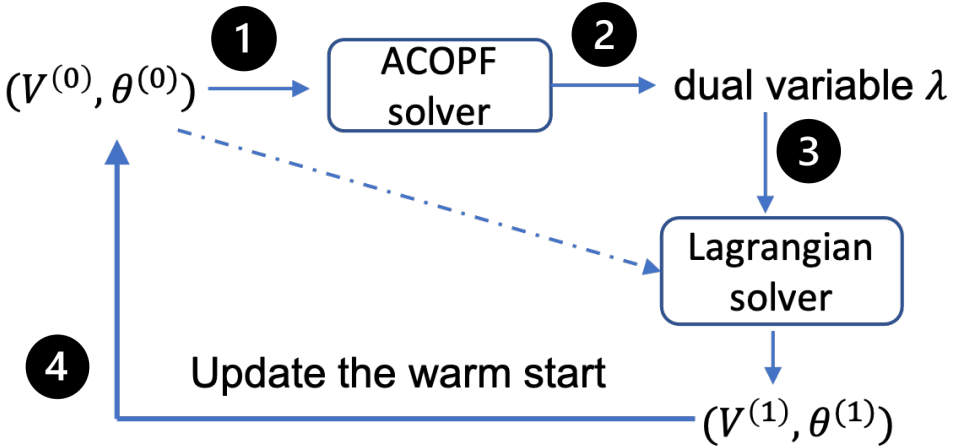
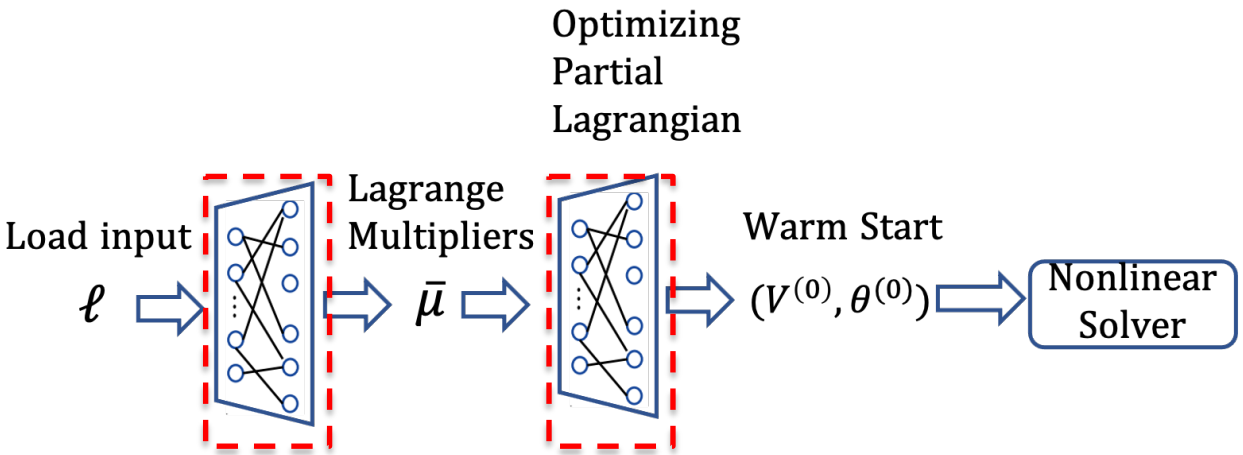
Our Algorithm

- **Escape from local solutions and find global solution iteratively**



Use Learning to Speed Up



Thanks