Towards Efficient and Effective Smart Grid Control

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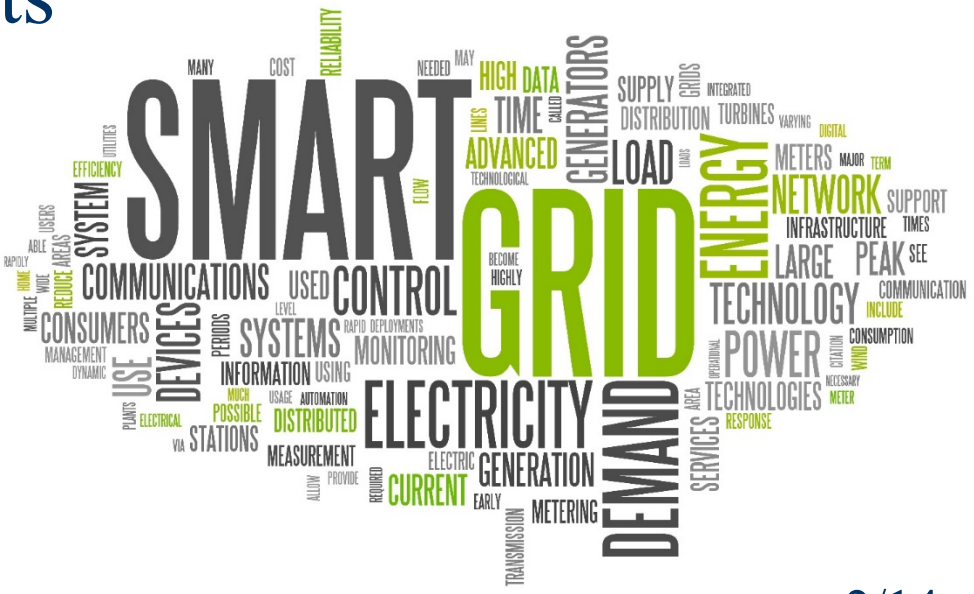
Less CO2 emissions and a more reliably power system





Outline

- Background Information
- Method: PSO + Grid Search
- Simulation and Results
- Conclusion



Background of Smart Grid

What is a Smart grid

"… an electricity supply network that uses digital communications technology to detect and react to local changes in usage…"

Why do we need it

Decrease cost, waste, and response time:

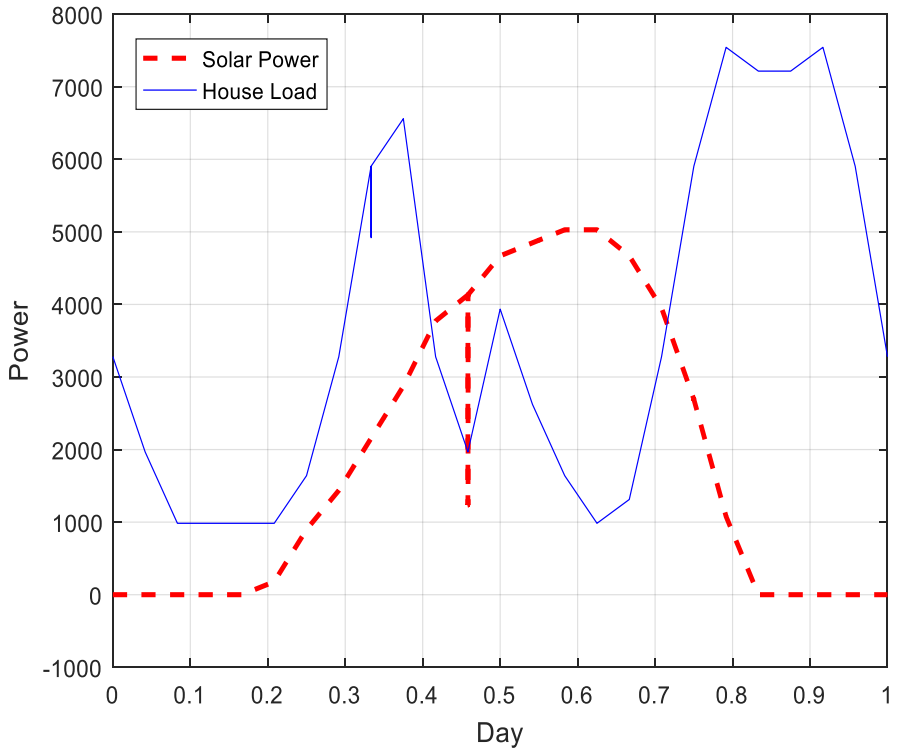
- Easier add distributed generation and storage
- Coordination and Communication
- Detect errors

Challenges of Smart grid Optimization

-Uncontrolled production and demand

-New generation sources need to be able to be introduced easily

-Transient surges of power



Need for smarter controllers

What is: Particle Swarm Optimization

-A way of searching for an optimal point

-Originally based on a flock of birds

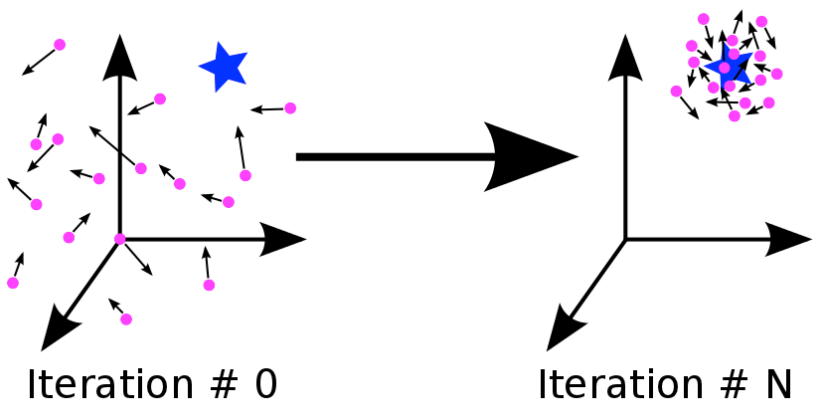
-Searches for best “food” location through communication

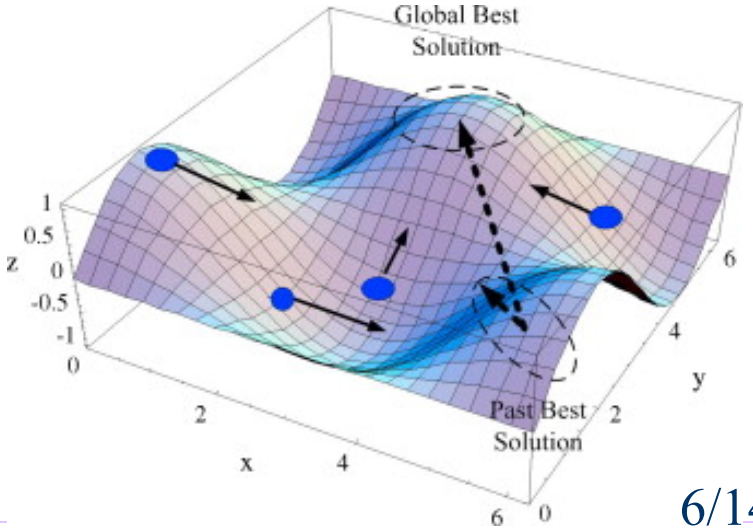
How: Particle Swarm Optimization

-Starts randomly and compares particles location to personal and global best

-Moves toward best location at partially-random velocity, overshoots, repeats

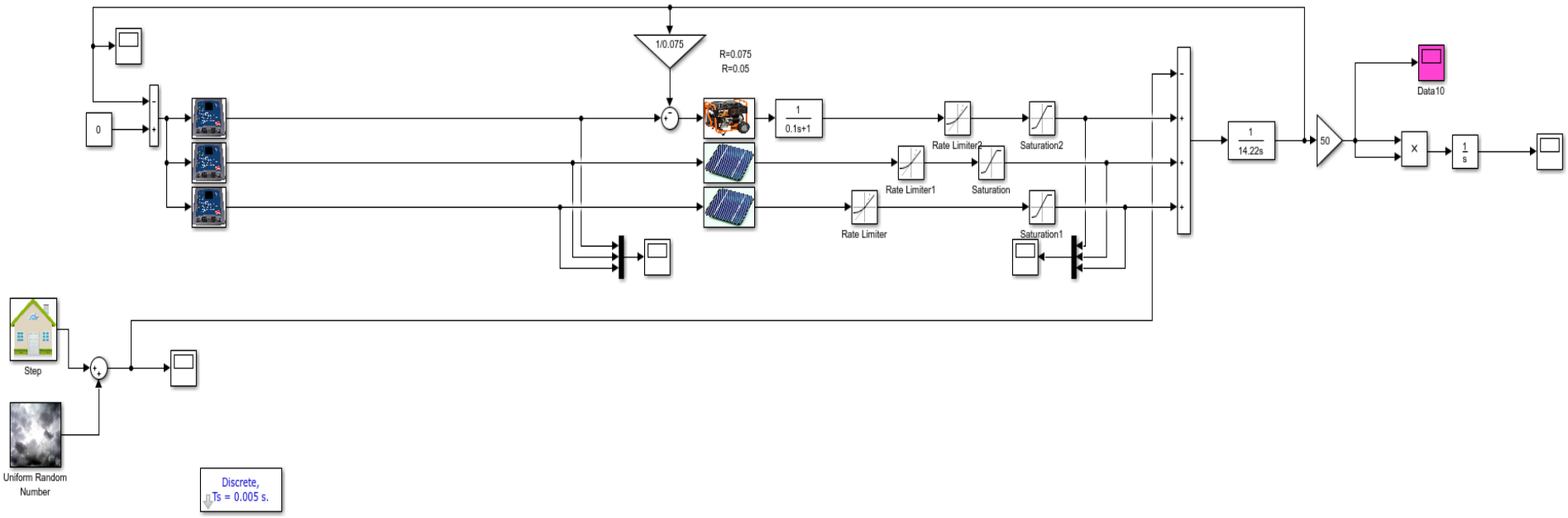
$$V^{k+1}=\mathrm{W}*V^{k}+c1*rand*\left(Pbest-x^{k}\right)+c2*rand*\left(Gbest-x^{k}\right)$$
$$x^{k+1}=x^{k}+V^{k+1}$$





Smart Grid Simulation Model

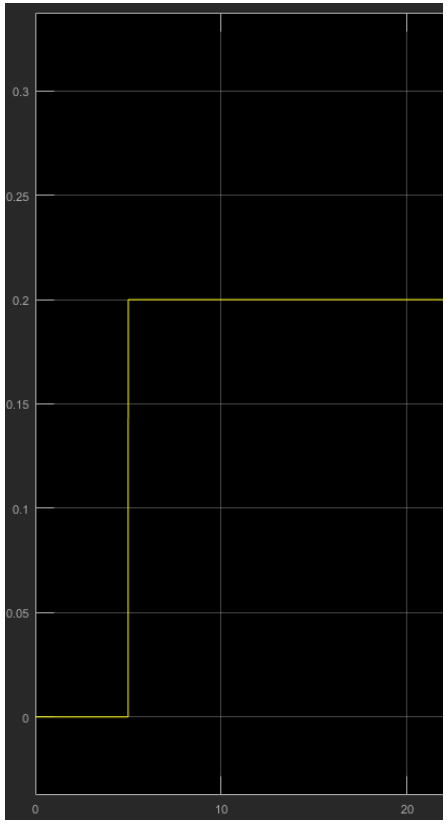
Home Load, Cloud Shading and Solar Panels, Generator, Controllers…



Simplified vs Realistic Models

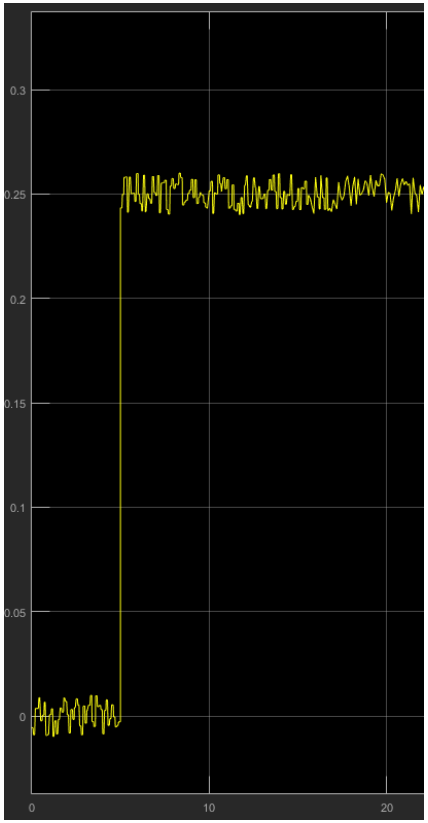
Simple:

Load put on the system



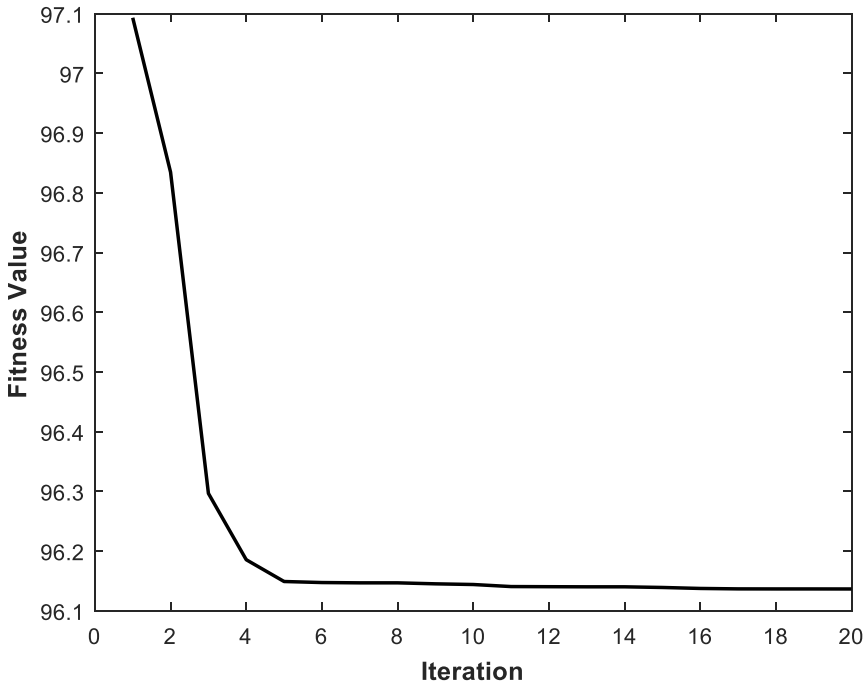
Realistic:

Load put on the system, with the noise from distributed generation

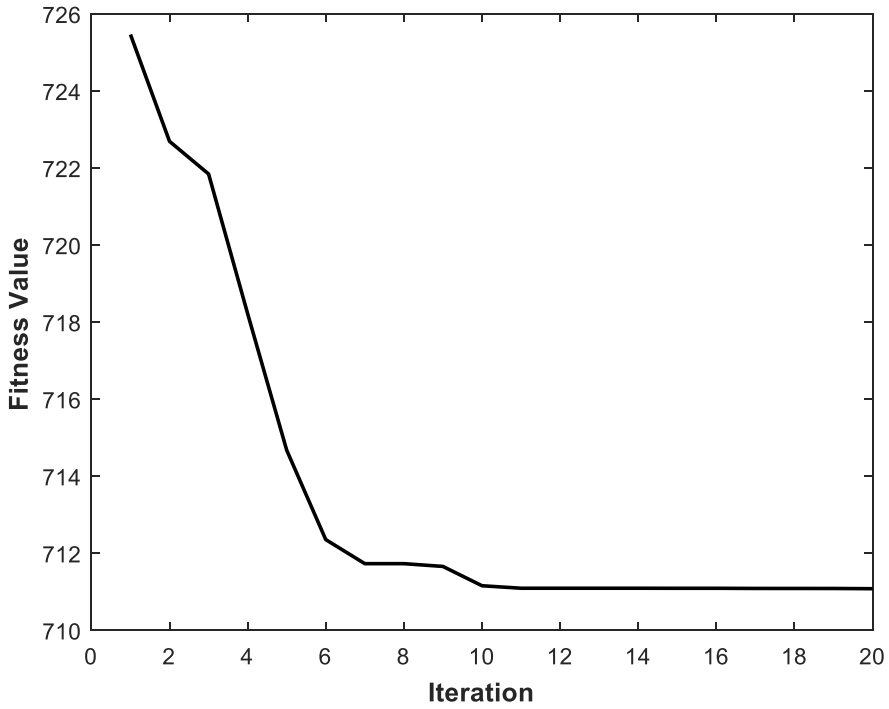


PSO fitness vs. iteration

Simplified Model



Realistic Model



PSO vs Grid Search: Simplified Model

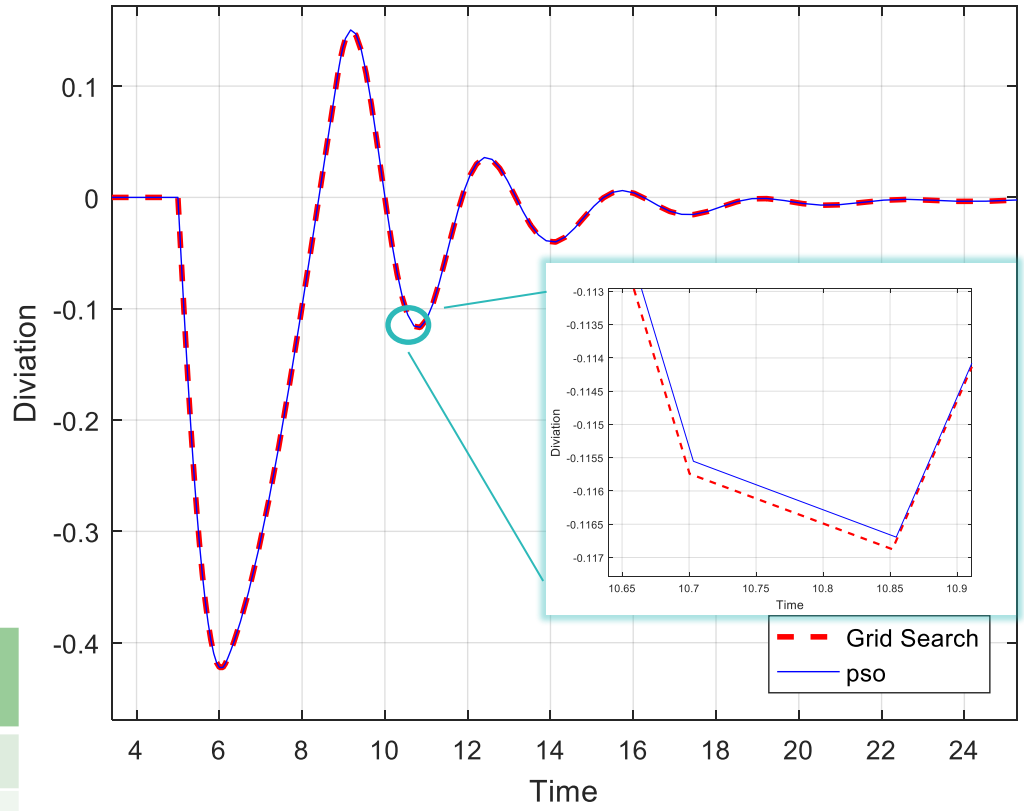
-Grid Search

525.5 min

-PSO

20.9 min (Over 26 times faster)

	Time (min)	P	I	Fitness
PSO	20.86	27.287	3.5184	96.098
Grid Search	525.5	27.3	3.5	96.1185



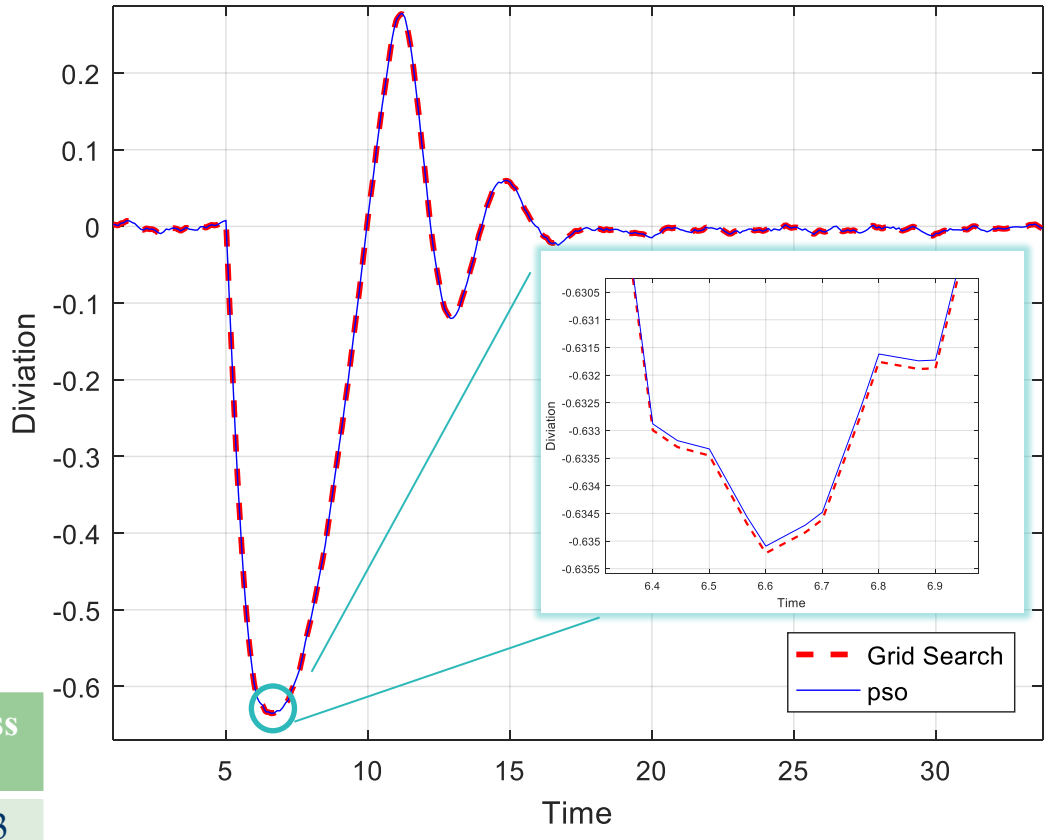
PSO vs Grid Search: Realistic

-Grid Search

487.7 min

-PSO

21.1 min (23 times faster)



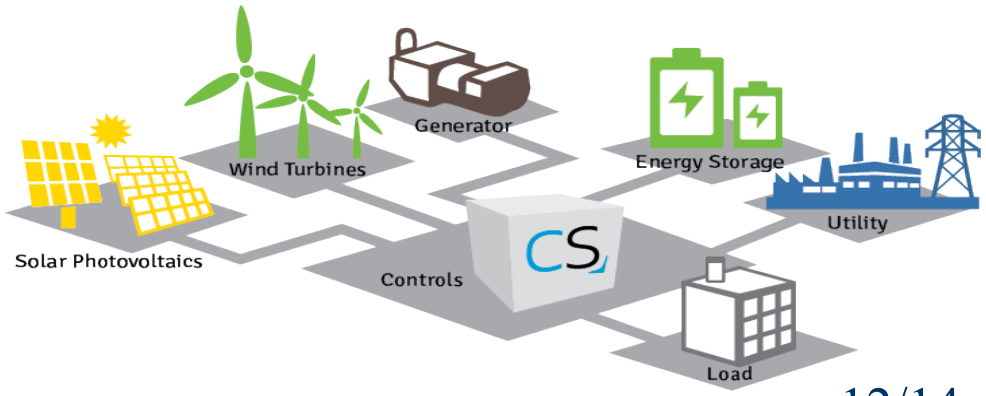
	Time (min)	P	I	Fitness
PSO	21.12	22.019	2.152	710.83
Grid Search	487.72	22	2.15	710.91

Conclusion

-Smart grid is the future of power systems

-It brings new challenges, such as frequency fluctuations

-Smart controllers can deal with these challenges through use of Particle Swarm Optimization



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