Y9.ET1.3 Reputation-based Distributed Resilient Cooperative Distributed Energy Scheduling Algorithm
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Overview
Background
- A paradigm shift from centralized to distributed control in power system
- Distributed energy management algorithms to determine the optimal operational point for microgrids
- Vulnerable to malicious cyber attacks, which might lead to economic losses or even system breakdowns.

Problem statement
- Design a resilient distributed control strategy to secure the distributed energy management algorithm:
  - Detect and respond to potential cyber attacks
  - Maintain the optimal operational point in the adversary environment
  - Implement the resilient control strategy in DGI 2.0

Method
Technical Approach
- A novel data integrity attack on FREEDM system
  - A malicious DESD misleads the system with false information
  - The malicious DESD maximizes its economic benefit while satisfying all the system constraints

Reputation-based neighborhood watch algorithm
- Two-hop communication neighbors collaboratively detect false information
- A Reputation index quantifies the neighbors’ behavior history

Case Study
- 3-node GEH system, DESD 1 is malicious with the objective to maximize its own profit

Results

References

On the Horizon
- Implement the Reputation-based resilient distributed control algorithm in DGI 2.0

Table I: The economic impact of attack on FREEDM System

<table>
<thead>
<tr>
<th>Benefit (cents)</th>
<th>Total Bill</th>
<th>DESD 3</th>
<th>DESD 1</th>
<th>DESD 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>187.02</td>
<td>26.08</td>
<td>38.56</td>
<td>22.35</td>
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<tr>
<td>Attacked</td>
<td>208.55</td>
<td>34.06</td>
<td>35.98</td>
<td>17.03</td>
</tr>
<tr>
<td>Difference</td>
<td>+21.53</td>
<td>+7.98</td>
<td>-2.58</td>
<td>-5.32</td>
</tr>
<tr>
<td>Impact (%)</td>
<td>+11%</td>
<td>+30%</td>
<td>-6%</td>
<td>-23.6%</td>
</tr>
</tbody>
</table>

Figures:
- Fig.1 Malicious attacks on distributed control framework
- Fig.2 Attacking Strategy for the malicious DESD
- Fig.3 Reputation-based neighborhood watch algorithm
- Fig.4 Data Integrity Attack on FREEDM system
- Fig.5 The power schedule with/without attack
- Fig.6 The change of reputation index under attack