Sandia-Performance-Model Quality Tests in Sandia Pecos for Near-Real-Time Detection of Anomalies

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Motivation and Methodology

- CFV uses Sandia Pecos to check the quality of its outdoor test data daily (instrument failures, wiring errors, etc).
- Can we detect even subtle anomalies with performance-model-based quality tests?

Deriving Sandia-Array-Performance-Model Coefficients

- Coefficients were derived on eleven different arrays* based on 2018 Q4 data; AOI and spectral effects were ignored.

Performance-Model-Based Quality Indices, for Use with Pecos Range Tests

<table>
<thead>
<tr>
<th>Index</th>
<th>Definition</th>
<th>Applied On</th>
<th>For Detecting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual RMSE</td>
<td>(Measured Value – Model Value)/RMSE; RMSE from 2018 Q4 residual analysis</td>
<td>Imp, Pmp</td>
<td>Inverter failures/anomalies, shading events, fuse failures, instrument failures/anomalies, etc.</td>
</tr>
<tr>
<td>Measured Range</td>
<td>(Measured Max – Min)/(Model Max – Min)</td>
<td>Vmp</td>
<td>Instrument failures/anomalies, etc.</td>
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<tr>
<td>Expected Range</td>
<td></td>
<td></td>
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</tbody>
</table>

Normal Operation

- Clear-Sky Day QCI = 1.0000
- Cloudy Day QCI = 0.9975

Failures/Anomalies

- Inverter Not Tracking QCI = 0.9872
- Snow Cover (Melting Away) QCI = 0.9878
- Voltage Transducer Failure QCI = 0.5293
- Voltage Reading Not Updating QCI = 0.9952

Summary + Future Improvements

- Pecos range tests on performance-model-based quality indices help detect failures and anomalies quickly.
- Residual/RMSE indices lead to false positives on cloudy days => Apply only to clear sky points? Match time constants?

* Data and arrays are not owned by CFV. Data is used with permission from the owner.