The Outdoor Bifacial Test Facility at Technical University of Denmark

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Background: Since summer 2018, European Energy A/S and DTU have measured the performance of bifacial PV strings mounted on trackers and fixed tilt systems located in Northern Europe (55.6° N, 12.1° E). A new publically funded project is underway with the intent to evaluate in-house and commercially available bifacial PV performance models. The facility includes several sub-systems where the conditions known to affect bifacial performance are varied including tracker spacing (GCR), albedo (ρ) and module tilt (β).

Equipment and Layout
- Monofacial and bifacial strings of similar front side power mounted side-by-side.
- Horizontal East-West (HSAT) trackers (x8) and south facing 2V racks with adjustable tilt angle (x8).
- Tilted single axis trackers (x2) and dual axis tracker (x1).
- Multiple ground covers under test:
  - Seasonal grass (ρ ≈ 20%)
  - Coarse sand (ρ ≈ 28%)
  - Medium-size gravel (ρ ≈ 26%)
  - White polymeric tarp (ρ ≈ 76%)
  - μ-structured reflector (ρ ≈ 63%)

Sensors and Detailed Monitoring
- Max-power current (\(I_{\text{max}}\)) and voltage (\(V_{\text{amp}}\)) measurements on 64 individual strings.
- DC Power meters with isolated surface mount resistors and digital filtering.
- Spectroradiometers for diffuse and beam measurements (300-1100 nm) for investigation of spectral effects.
- Albedo sensors at four locations around the facility.
- Tracker error monitor for single axis trackers.

Performance Modeling
We are using the onsite meteorological data as inputs to bifacial PV models. The model's output is then compared to our electrical measurements. View factor models under consideration currently include MoBiDiG (ISC Konstanz), PVsyst, and SAM. Ray trace models currently being tested include Zemax and Radiance.

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