Hybrid Model for Photovoltaic Power Plant Service Life

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HYBRID MODEL

Modeling interactions between **discrete** and **continious variables** and integrating laboratory studies and real-world massive datastream into a **stress → mechanism → response** framework with predictive capabilities.

Focus on the **dynamic reliability methods**. The dynamic model represents the time-dependent aspect of a system and it is concerned with the temporal changes in the states of the objects in a system.

Can we identify the failure modes and their specific patterns from the data?

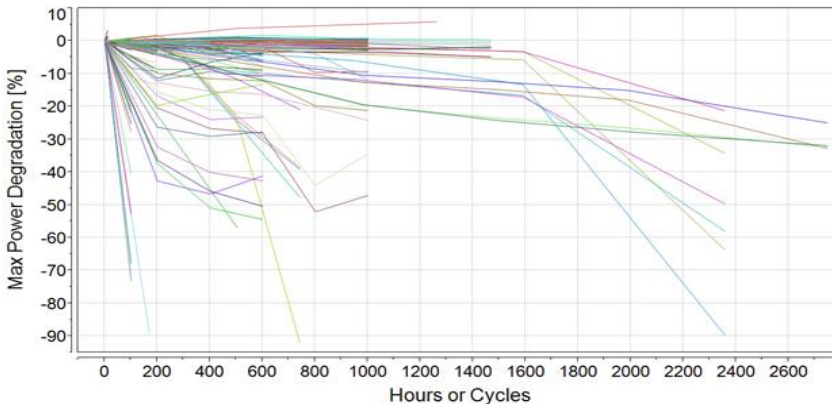Example of accelerated testing results:

Figure: Degradation Results of More Than 200 PV Modules Subjected to Reliability Testing at PV Evolution Labs, 2012

Current approach:
- Performance ratio (PV)
- Regression modeling (PVUSA)

Problems:
- Usually just deterministic
- May not generate usefull insights
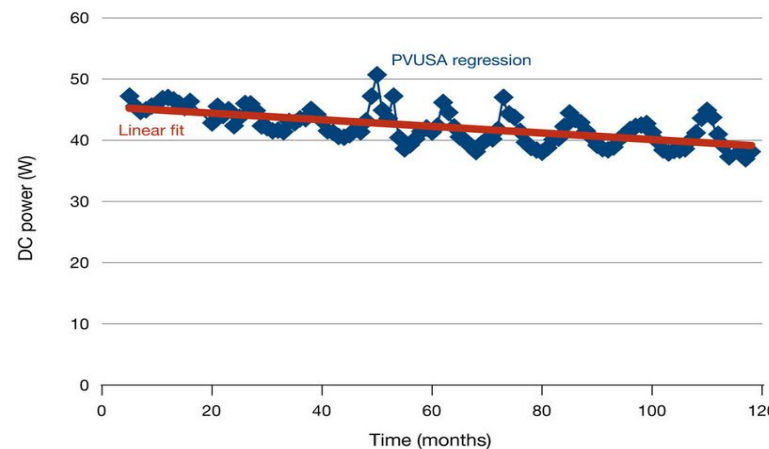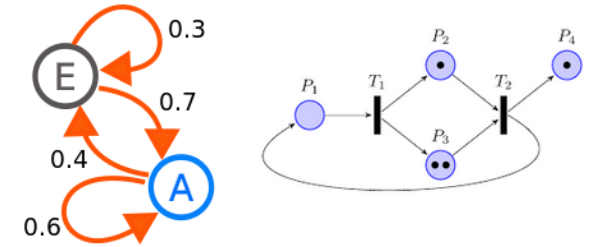- How to incorporate uncertainties
- Is the linear extrapolation suitable?

Figure: Evaluation of the Performance of the PVUSA Rating Methodology NREL,J. Dirk,S. Kurz, 2012

Dynamic Modeling Approach:

- **Piecewise Deterministic Markov Process**

- **Petri network**

- **Stochastic hybrid fault tree approach**

For more realistic degradation rates the focus needs to be on the dynamic modeling approach with incorporated uncertainties