Fast Learning for Immersive Engagement in Energy Simulations

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Overview

Motivation
- Visualization-driven design, exploration, and analysis of energy simulations is becoming central to leading-edge projects at NREL.
- To leverage large computational resources more fully, we must develop scalable, interactive visualization and exploration techniques.

Objectives
- Develop general methods for rapidly computing simplified versions of energy models.
- Quantify accuracy/fidelity of approximations.
- Provide interactive visualization of multidimensional timeseries output.

Aspects of Case Study Applications
- Rapid, interactive, visual design and exploration of scenarios with sponsors associated with energy models.
- Vividly communicate feature discoveries.

Approach (4 phases of 6 months each)
- Statistical methods to deal with high-dimensional data.
- Reduced-dimensionality techniques.
- Functional regression and principal components analysis.
- Interactive visualization of high-dimensional spaces.

Inputs
- High dimensional input space.
- Input Data

Outputs
- Reduced-dimensionality output.
- Output Data

Rapid, interactive, visual design and exploration of scenarios with sponsors associated with energy models.

Input Data

Choice of Training and Testing Data
- Statistical models require a representative sample of "training" data.
- The training data should span the parameter ranges of interest.
- Parameters not of interest should be set to their default values.
- The density of training data over the input parameter space should also match the density of interest in that part of the parameter space.

Examples of Input Designs

Reduced-Dimension Input

Reduced-Form Model

Output Data

Measurement of Dimensionality
- The empirical dimensionality of a dataset is estimated using a pseudotimes.
- A pseudotimes is constructed from either a persistence diagram or a sequence of pseudovariables.
- The empirical dimensionality of a pseudotimes is estimated using a persistence diagram.

Reduced-Dimension Output

Reduced-Form Model

ProtoBuf3

ProtoBuf3

WebSockets

WebSockets

Output data from the simulations and the results of the fitting will be visualized using both standard graphics tools and also the capabilities of NREL's Advanced Energy System Design Platform, such as interactive visualization and advanced data integration (EDI).

This work was supported by the U.S. Department of Energy under Contract No. DE-AC36-08GO28308 with Alliance for Sustainable Energy, LLC, the Manager and Operator of the National Renewable Energy Laboratory. Funding provided by the Laboratory Directed Research & Development Program. This research was performed using computational resources sponsored by the Department of Energy's Office of Energy Efficiency and Renewable Energy and housed at the National Renewable Energy Laboratory.

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.