Marine and Hydrokinetic Toolkit (MHKiT)

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Importance of Data in Marine Renewable Energy Development

The ability to collect, ingest, condition, reduce, quality control, process, visualize, and store data is critical at all stages of Marine Renewable Energy (MRE) research and technology/project development.
MHKiT Solves Problems and Adds Value

A verified suite of MRE data processing functions:
• Eliminates the common code creation across the MRE field
• Offers standardized, referenceable, and readable code base
• Enables rapid data processing
• Creates a data flow of quality control (QC), analysis, and visualization
• Offers a common development platform across the MRE community where issues are discussed, and features are expanded
• Assists developers in device certification for insurance, regulator bodies, and investors
MHKiT is developed as a collaboration between the National Renewable Energy Laboratory (NREL), Pacific Northwest National Laboratory (PNNL), and Sandia National Laboratories (SNL). The core development team is listed below:

- Frederick Driscoll (NREL - PI)
- Rebecca Fao (NREL)
- Budi Gunawan (Sandia - PI)
- Hristo Ivanov (NREL)
- Katherine Klise (Sandia)
- Sterling Olson (Sandia)
- Kelley Ruehl (Sandia)
- Timothy Shippert (PNNL)
- Chitra Sivaraman (PNNL - PI)

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https://MHKiT-Software.github.io/MHKiT/
MHKiT is open-source software, developed in Python and MATLAB, for data processing, visualization, quality control, resource assessment, and device performance.

- **MHKiT-Python**: Software developed in Python
- **MHKiT-MATLAB**: Software developed in MATLAB

[https://github.com/MHKiT-Software](https://github.com/MHKiT-Software)
MHKiT-Python and MHKiT-MATLAB are organized into the following modules:

- **QC Module**: Perform quality control analysis
- **Wave Module**: Calculate quantities of interest for wave energy converters (WEC)
- **River Module**: Calculate quantities of interest for river energy converters (REC)
- **Tidal Module**: Calculate quantities of interest for tidal energy converters (TEC)
- **Power Module**: Calculate quantities of interest for power production and power quality
- **Loads Module**: Calculate quantities of interest for mechanical loads assessments
- **Utils Module**: Includes helper functions

These modules provide functionality for calculating metrics needed by the MRE community as well as those required for conformity with IEC TS and recommendations.

To ensure **consistent results between MHKiT-Python and MHKiT-MATLAB**, all functions are written in Python and housed in the MHKiT-Python repository. MHKiT-MATLAB then wraps these functions so they can be called from MATLAB.

MHKiT-Python includes continuous integration software tests that are run using [Travis CI](https://travis-ci.org).

[https://MHKiT-Software.github.io/MHKiT/overview.html](https://MHKiT-Software.github.io/MHKiT/overview.html)
MHKiT: Python & MATLAB

MHKiT Python User

Interact with MHKiT using Python

MHKiT MATLAB User (with MHKiT-Python Installation)

Interacts with MHKiT using MATLAB

Handles calls to and data from MHKiT Python
MHKiT includes examples to demonstrate functionality:

- **Wave example**: generate a capture length matrix, calculate MAEP, and plot scatter diagrams
- **QC example**: run a simple quality control analysis on wave elevation data
- **River example**: calculate annual energy produced for one turbine in the Tanana river near Nenana, Alaska
- **Tidal example**: calculate velocity duration curve using 1 year of data from the NOAA-Currents sites
- **Power example**: calculate power characteristics and current harmonics
- ** Loads example**: calculate damage equivalent loads and loads statistics

https://mhkit-software.github.io/MHKiT/python.html#examples
https://mhkit-software.github.io/MHKiT/matlab.html#examples
Future Development

- Additional QC functionality and data transformations
- MHKiT-Cloud for near real-time processing
- Expanded module capabilities
  - River
  - Tidal
  - Mechanical Loads
  - Power Quality
- Additional graphics and reporting functions
- WEC-Sim, wave resource, and common measurement IO functions
- Mooring Module

https://MHKiT-Software.github.io/MHKiT/release_notes.html
Online Forum

Issues

Questions, feature requests, and bug reports for MHKit-Python and MHKit-MATLAB should be submitted to the GitHub Issues Page. The GitHub online forums are managed by the MHKit development team and users.

Submit MHKit-Python Issue
Submit MHKit-MATLAB Issue

Collaboration

MHKit-Python and MHKit-MATLAB welcomes feedback and code contributions. Software developers interested in contributing to the MHKit open-source software are encouraged to use GitHub to create a Fork of the repository into their GitHub user account. To include your additions to the MHKit code, please submit a pull request in the master branch of the . Once reviewed by the MHKit development team, pull requests will be merged into MHKit master branch, and included in future releases of MHKit. Software developers, within the MHKit development team and external collaborators, are expected to follow standard practices to document and test new code.

Submit MHKit-Python Pull Request
Submit MHKit-MATLAB Pull Request

https://MHKit-Software.github.io/MHKiT/contact.html
Thank You!

Further Information:

- MHKiT Documentation: [https://mhkit-software.github.io/MHKiT/](https://mhkit-software.github.io/MHKiT/)
- email: Rebecca.fao@nrel.gov