LSW meets Matlab Expo

Streaming Data Analytics for Energy Asset Health Monitoring on a Data Science and IIoT Platform
We have to change something! Climate change is one of the biggest challenges of our generation. We need an energy revolution moving to renewable energies. Wind energy is one of the most important technologies on the way to the future. Wind farms offer an interesting field of application for data analysis and IoT platforms. Wind turbines generate a lot of data, from which big knowledge can be generated with the help of data analytics. We show how Matlab and other technologies can be used to build a technologically sustainable IIoT & Data Science platform to help us generate the energy of the future.
Who are the speakers

Emma Haley
Leipziger Stadtwerke (Germany)
Language & Data Nerd

Stefan Hartleib
Leipziger Stadtwerke (Germany)
Versorgungswirtschaft, IoT und Nerd
content for you

1. A little girl & climate change
2. What can we do to improve the world?
3. Wind power & use cases for data analysis
4. Example - digital twin with a simple anomaly detection
We must change something

“2018, before Covid-19, a little girl reminded us of one of the most important challenges for our world.”

[1] Website, 05.03.2021, https://twitter.com/GretaThunberg
What can we do to improve the world?

for example: change to renewable energies
Wind power in Germany - 2020/21

"on a day wind power produces up to ~50% of the energy in Germany..."
Wind power use cases for data analysis: two examples
Wind power & the ice problem

Ice on the wings of wind turbines reduces the efficiency by 15%. At which point are they iced and how can you detect this from the data?
Wind power - forecast the power output

Energy must always be available. But when does a wind farm generate how much energy?
Wind power use case for today:
Digital twin with a simple anomaly detection
Our Vision

We want to do Data Science at the same proficiency level as we do Software Development:

- High code quality
- High test coverage
- Transparency
- Explainability
- CI/CD
- 24/7
Our goal

Hey folks, I’m broken
The idea

Hey folks, wind turbine X is broken!

some corrupted data
The slightly more complex reality

Digital Twin

IoT - Device

steering signals

telemetry
The slightly more complex reality

The slightly more complex reality
The slightly more complex reality

Digital Twin

IoT - Device

Kafka

historical data

cleaned data

subscribe asset telemetry

subscribe asset telemetry and weather

messages

steering signals

telemetry
Some examples

A data driven power curve

The result of data cleaning in 7 steps

Our PC in comparison with the manufacturer's
The slightly more complex reality

MATLAB Production Server

Digital Twin

historical data

cleaned data

influxdb

forecast = power_curve(current_wind_speed)
if not forecast - margin < current_load \
< forecast + margin:
generate_event('Current load does not \
correspond to expected value')

subscribe asset telemetry

Kafka

messages

IoT - Device

steering signals

telemetry

subscribe asset telemetry and weather

generate messages
Why FaaS (function as service)?

- Easier maintenance
- Efficient quality management
- Global availability
- Do it once and for all!
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Developing a FaaS

1. Take time for a deep dive in your input data

Analysis of the relations between some of the data points sent by the turbines

The behavior of an asset which made us rethink our data cleaning pipeline
Developing a FaaS

2. Write nice, well documented code

```matlab
function TOut = smoothTelemetry(T)
    %SmoothData smoothes telemetry data with 2 minute time window.
    %
    % TestCase:
    %    NaN values will be preserved
    %
    % find NaN values and set them to missing. We do not want to fill NaN
    % values by smoothing data
    idxMis = ismissing(T);
    TSmooth = smoothdata(T, 'movmean', minutes(2));
    TSmooth.value(idxMis) = missing;
    TOut = TSmooth;
end
```
Developing a FaaS

3. Tests, tests, tests!

![Diagram showing traditional unit tests and methodical tests with handshake]

```
R =
1x27 TestResult array with properties:
   Name
   Passed
   Failed
   Incomplete
   Duration
   Details
Totals:
27 Passed, 0 Failed, 0 Incomplete.
53.8585 seconds testing time.
```
Function Deployment to the Matlab Production Server

- Continuous Integration & Deployment
- Different environments for different scopes:
  - Dev machine for unit tests and compilation
  - Prep machine for integration tests and development code
  - Prod machine for production

Gitlab Pipeline
#dataDrivenEnergyRevolution
Let's make the world a little better, every day with technology.

#dataDrivenEnergyRevolution
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