LSW meets Matlab Expo

Streaming Data Analytics for Energy Asset Health Monitoring on a Data Science and IIoT Platform

MATLAB EXPO 2021

Leipziger Stadtwerke

Summary

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 Covid19,
a little girl reminded us of
one of the most important
challenges for our world."*

Greta Thunberg ✔
@GretaThunberg

Vi barn gör ju oftast inte som ni säger åt oss att göra, vi gör som ni gör. Och eftersom ni vuxna skiter i min framtid, så gör jag det med.
Jag skolstrejkar för klimatet fram till valdagen.

Tweet übersetzen

9:27 vorm. · 20. Aug. 2018 · Twitter for iPhone

1.809 Retweets   **275** Zitierte Tweets   **6.807** „Gefällt mir"-Angaben

1850

Global
Temperature
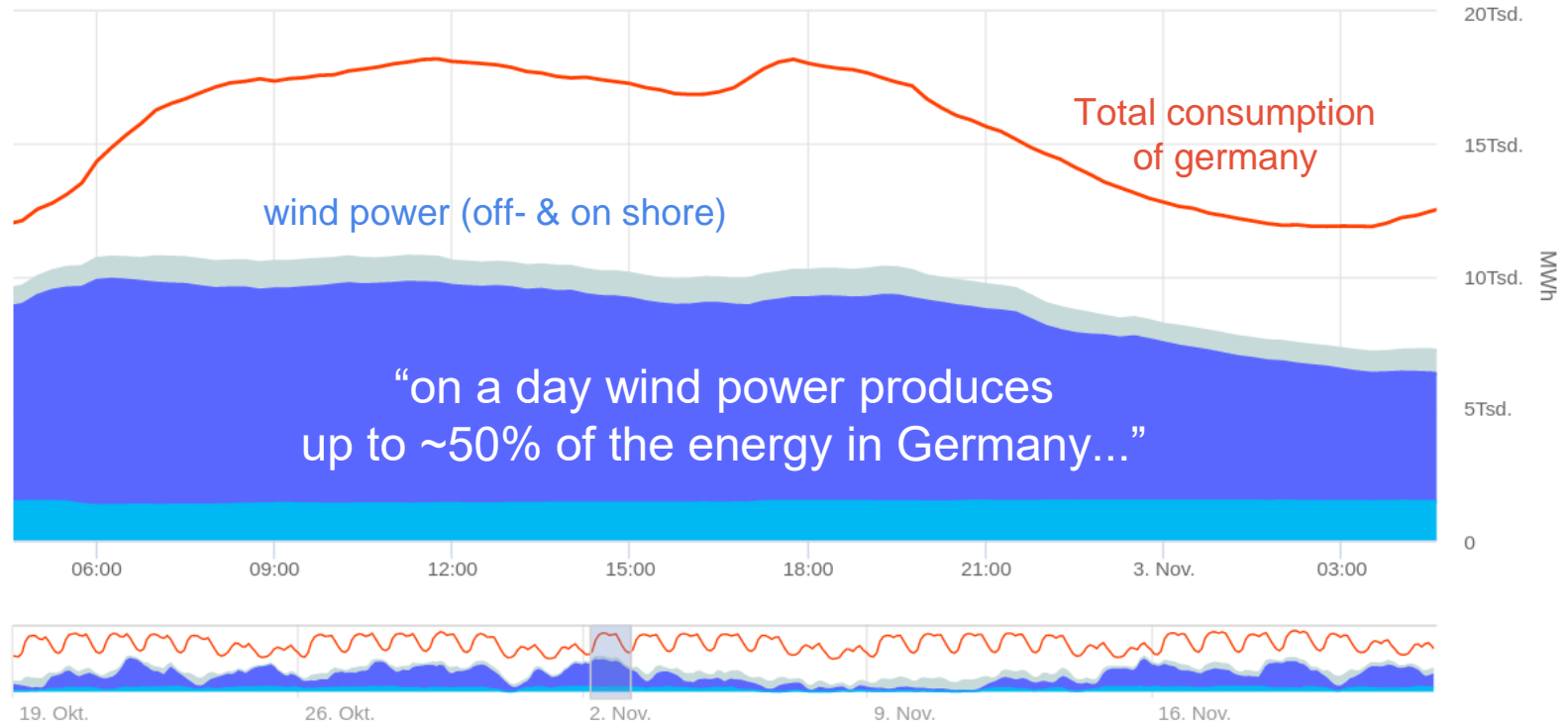
2020

What can we do to improve the world?

for example: change to renewable energies

[3] Website, 05.03.2021, https://pixabay.com/de/photos/kraftwerk-wasserturm-umwelt-energie-247147
[4] Website, 05.03.2021, https://pixabay.com/de/photos/windrad-windr%C3%A4der-windkraft-993017

Wind power in Germany - 2020/21

Total consumption of germany

wind power (off- & on shore)

"on a day wind power produces
up to ~50% of the energy in Germany..."

[5] Website, 07.03.2021, https://www.smard.de/page/home/marktdaten

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?

[5] Website, 07.03.2021, Vattenfall

Wind power - forecast the power output

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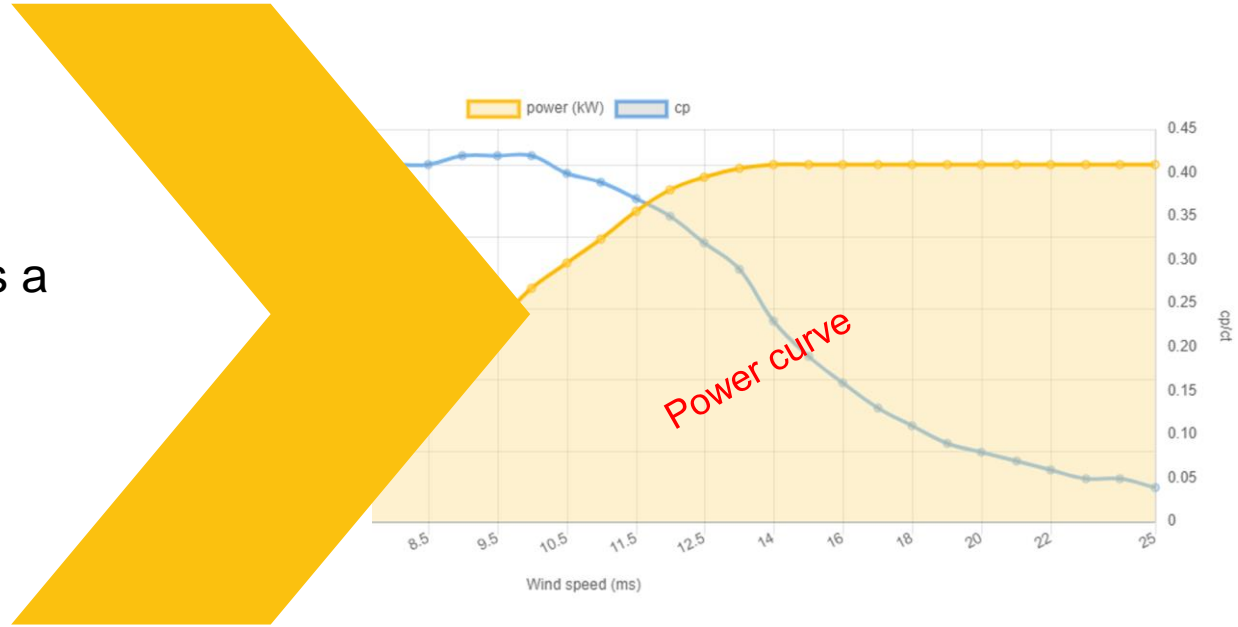
Wind power use case for today:
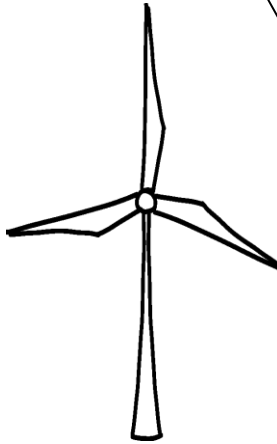Digital twin with a simple anomaly detection

Our Vision

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

- High code quality
- High test coverance
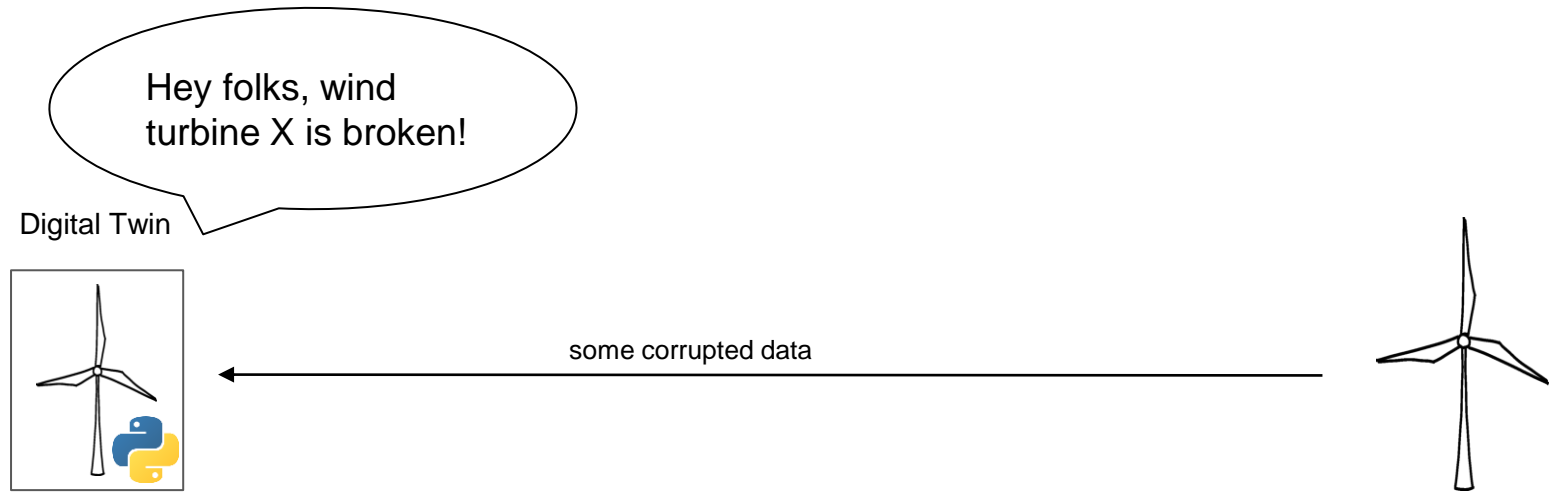- Transparency
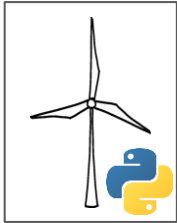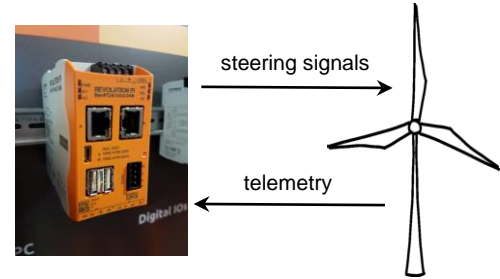- Explainability
- CI/CD
- 24/7

Our goal

The idea

The slightly more complex reality
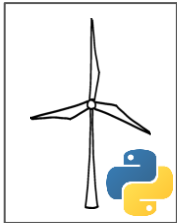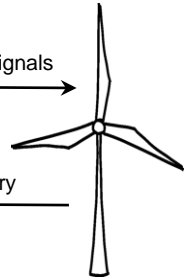

Digital Twin

IoT - Device

steering signals

telemetry

The slightly more complex reality

Digital Twin

subscribe asset telemetry and weather

Kafka

messages

IoT - Device

steering signals

telemetry

[6] Website, 07.03.2021, https://upload.wikimedia.org/wikipedia/commons/0/05/Apache_kafka.svg

The slightly more complex reality

influxdb

subscribe
asset
telemetry

Digital Twin

IoT - Device

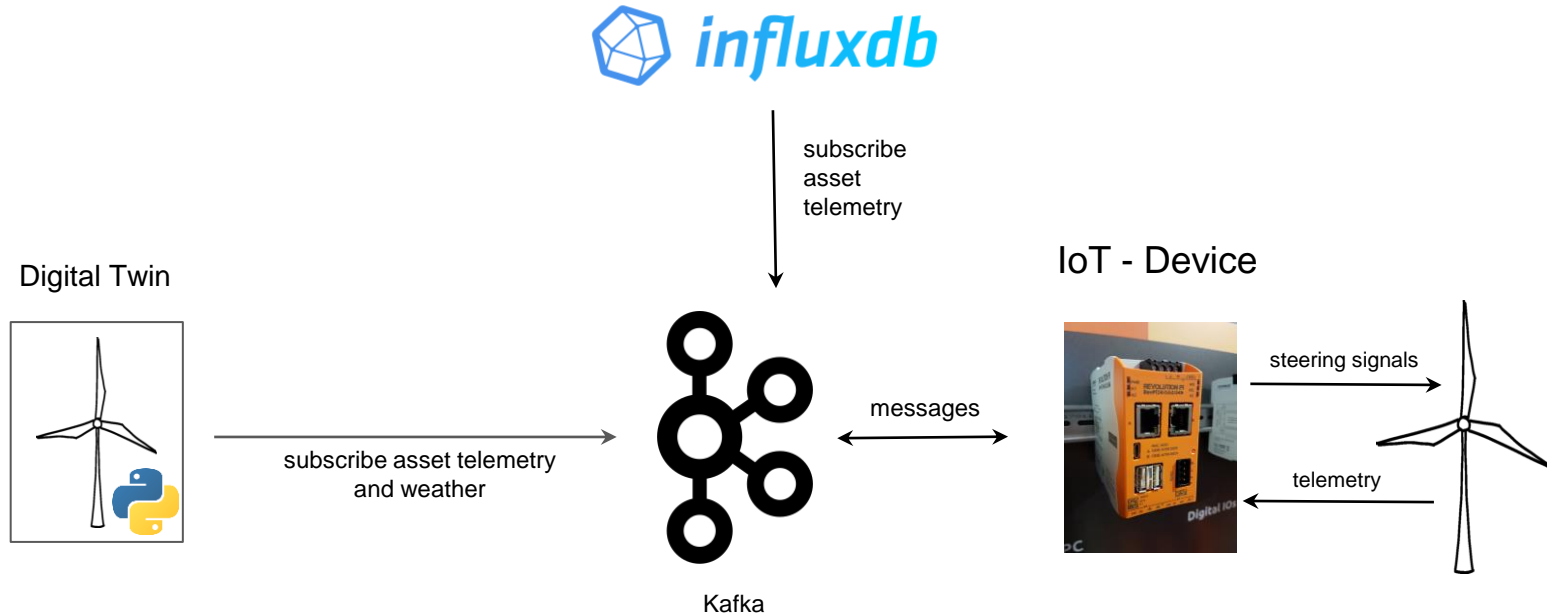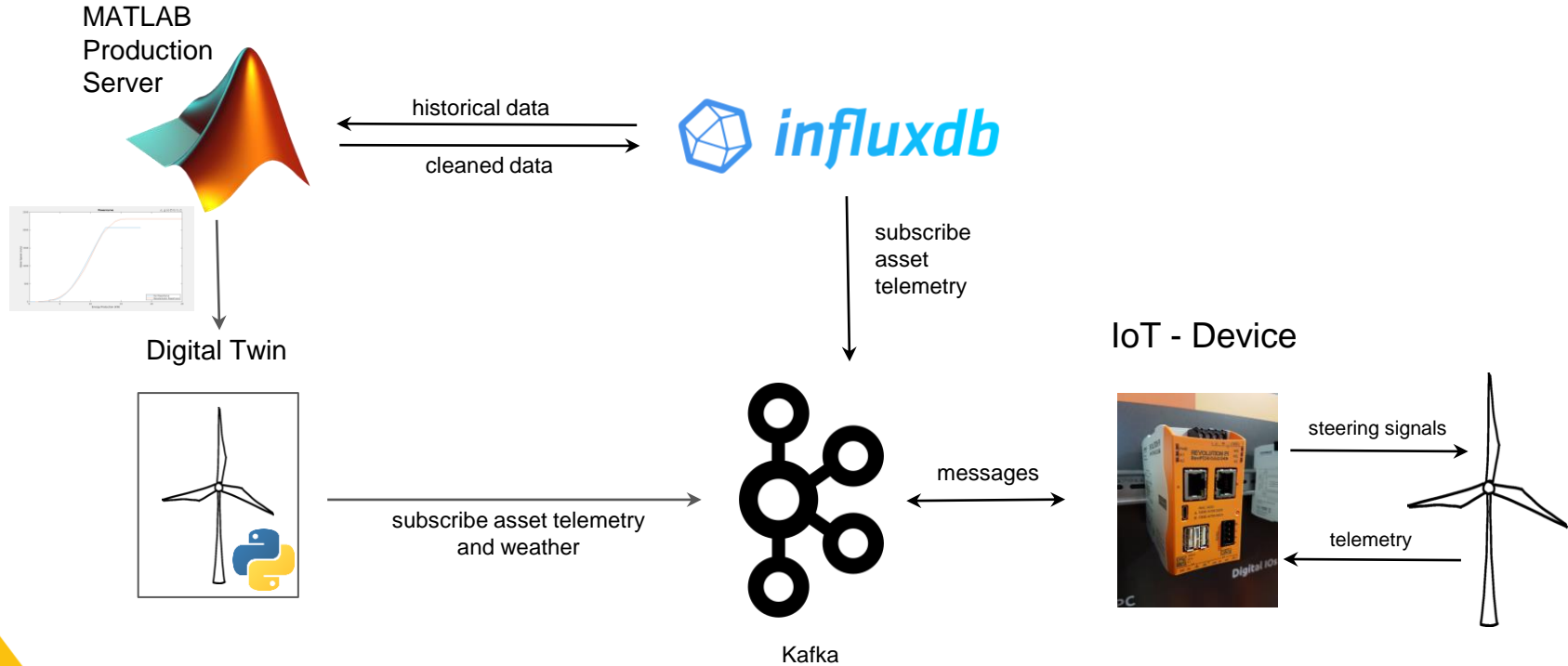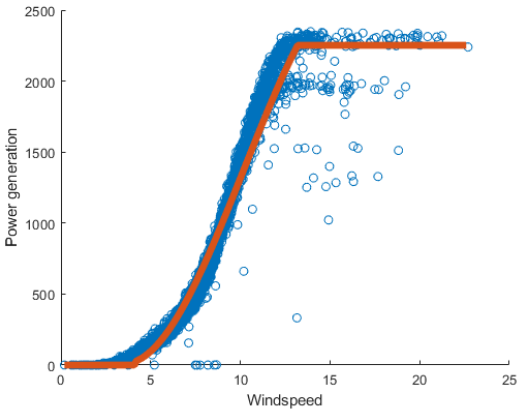subscribe asset telemetry
and weather

messages
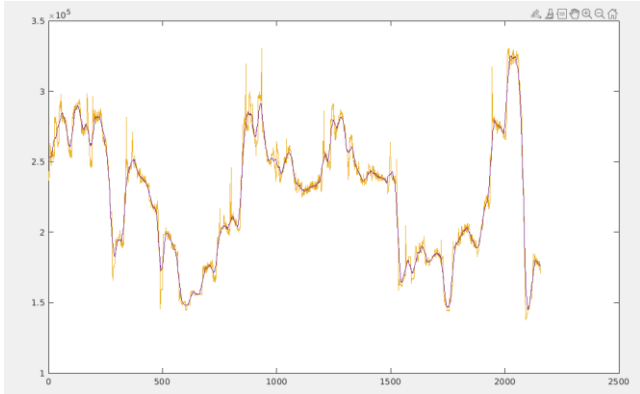
Kafka

steering signals

telemetry

The slightly more complex reality

MATLAB Production Server

historical data

cleaned data

influxdb

subscribe asset telemetry

Digital Twin

IoT - Device

subscribe asset telemetry and weather

messages

Kafka

steering signals

telemetry

[8] Website, 07.03.2021,https://upload.wikimedia.org/wikipedia/commons/2/21/Matlab_Logo.png

Some examples

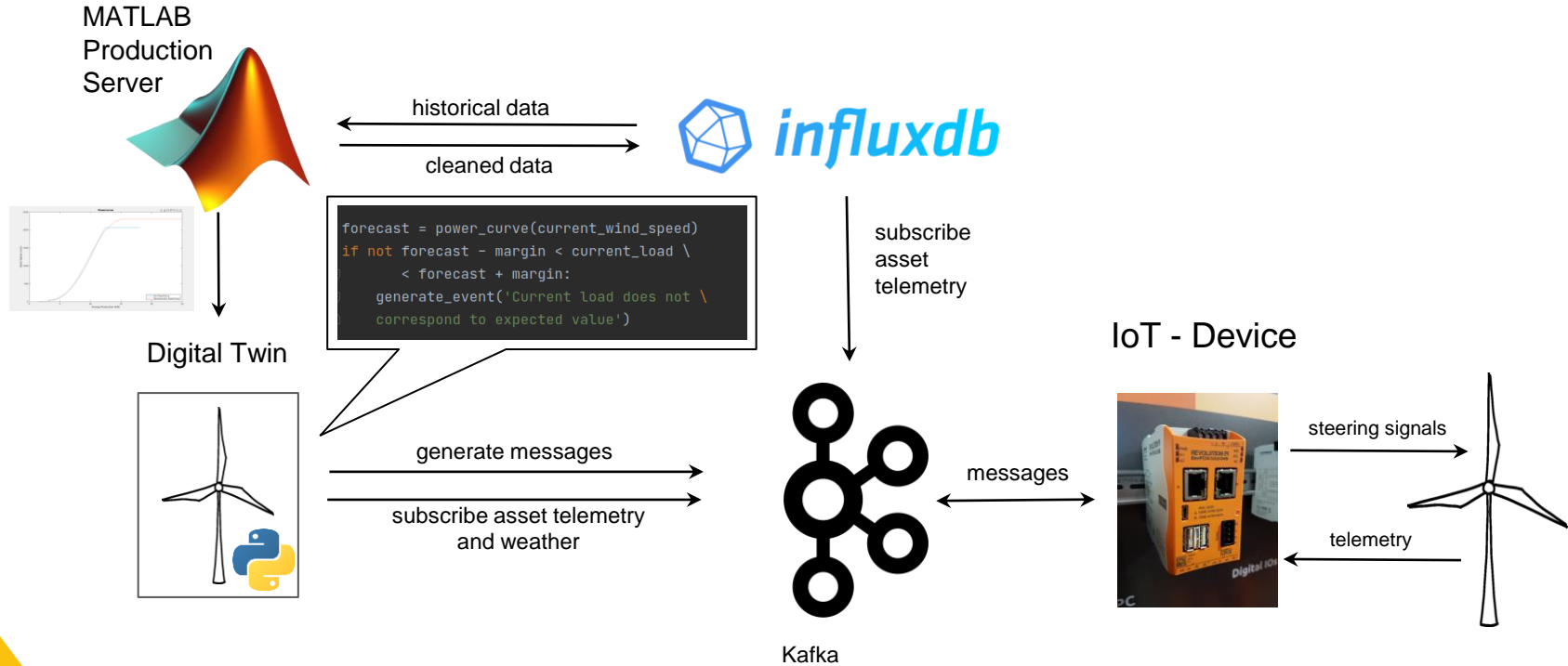A data driven power curve

The result of data cleaning in 7 steps

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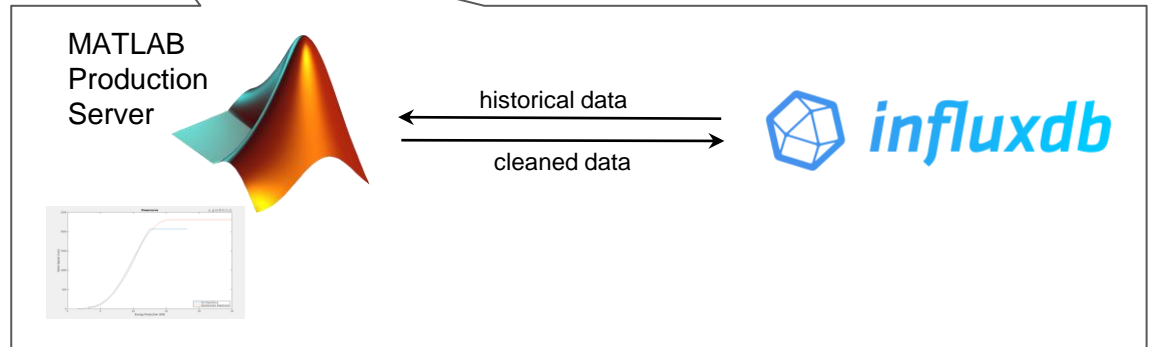
The slightly more complex reality

Why FaaS (function as service)?

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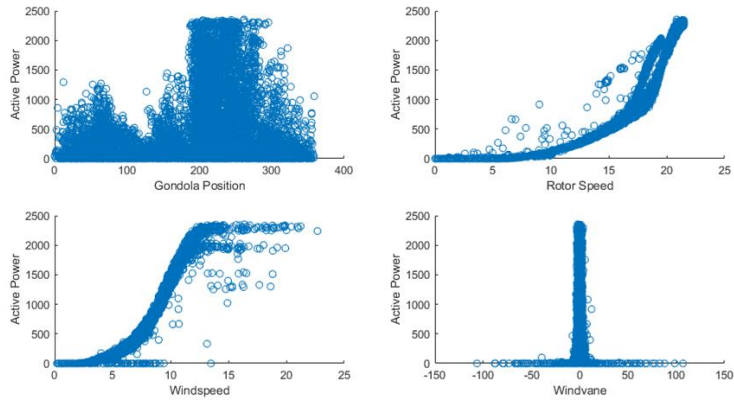- Global availability
- Do it once and for all!

Why FaaS (function as service)?

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

MATLAB
Production
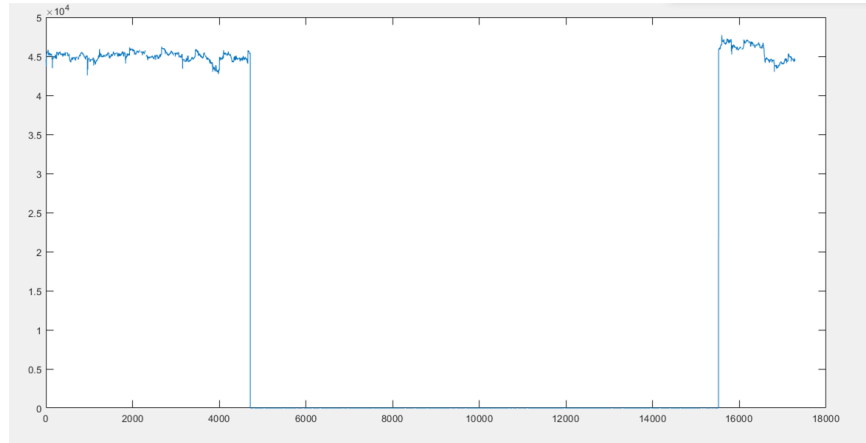Server

historical data

cleaned data

influxdb

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

Two-folks-principle!

```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
```
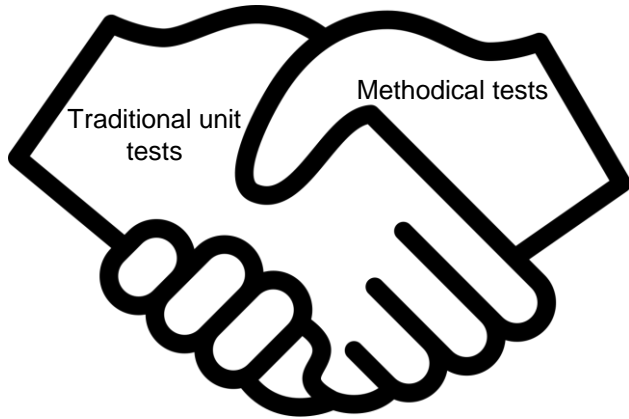
Developing a FaaS
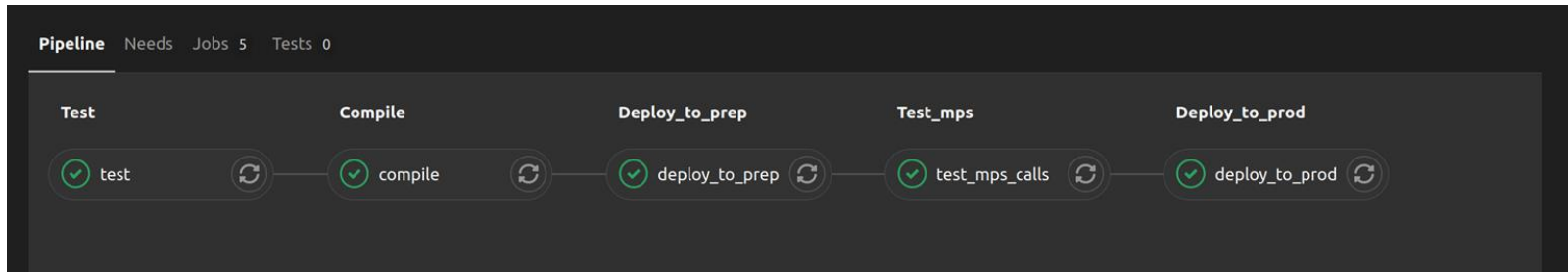
3. Tests, tests, tests!


```
R =
  1x27 TestResult array with properties:
    Name
    Passed
    Failed
    Incomplete
    Duration
    Details
Totals:
    27 Passed, 0 Failed, 0 Incomplete.
    53.8585 seconds testing time.
```

[9] Website, 08.03.2021, https://upload.wikimedia.org/wikipedia/commons/9/97/Handshake%2C_by_David.svg

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

#postgres #kafka #raspberrypi #matlab #java #python #influxdb #mqtt

[10] Website, 08.03.2021, https://pixabay.com/de/illustrations/jahrgang-retro-silhouette-schwarz-1318361/

Let's make the world a little better, every day with technology.

#dataDrivenEnergyRevolution

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