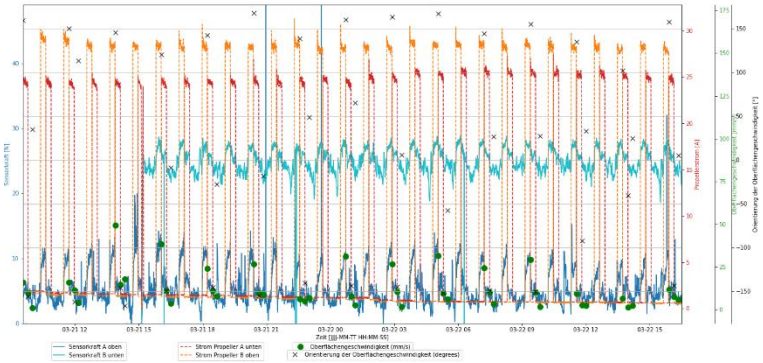
Professur für Regenerative Energiesysteme
Campus Straubing für Biotechnologie und Nachhaltigkeit
Technische Universität München

Master – Thesis **11.03.2025**

Data analysis of PIV measurements and CFD simulations on the mixing process in biogas plants

#Description



```
# Import necessary libraries
# (hypothetical for simulation and data analysis)
import numpy as np
import matplotlib.pyplot as plt
```

 # Task Definition

```
def literature_research():
    """Conduct a literature review on PIV measurements and CFD validation methods."""
    print("Step 1: Reviewing relevant literature...")


def define_target_parameters():
    """Define key target parameters for evaluating mixing efficiency based on PIV and CFD data."""
    parameters = ["Velocity distribution", "Turbulence intensity", "Mixing time"]
    print("Defined Target Parameters:", parameters)
    return parameters


def compare_piv_cfd_data(parameters):
    """Compare PIV measurements from real plant and model fermenter with existing CFD results."""
    datasets = ["Real Plant PIV", "Model Fermenter PIV", "Model Fermenter CFD"]
    results = {dataset: {param: np.random.rand() for param in parameters} for dataset in datasets}
    print("Comparison of PIV and CFD data:", results)
    return results


def analyze_geometry_comparison(parameters):
    """Use existing CFD data to compare different geometries based on defined target parameters."""
    geometries = ["Real Plant", "Model Fermenter", "CFD Model"]
    results = {geo: {param: np.random.rand() for param in parameters} for geo in geometries}
    print("Comparison of geometries based on target parameters:", results)
    return results


def derive_sensor_positioning():
    """Analyze CFD and PIV data to derive positioning criteria for a mixing quality sensor system."""
    print("Deriving optimal sensor positioning criteria based on data analysis...")
    # Placeholder for logic to determine best sensor placement
```

```
def improve_experiments():
    """Suggest improvements for future PIV experiments to enhance data quality."""
    print("Providing recommendations for experimental improvements...")
    # Placeholder for improvement suggestions

# Execution Order
if __name__ == "__main__":
    literature_research()
    params = define_target_parameters()
    results_piv_cfd = compare_piv_cfd_data(params)
    results_geometry = analyze_geometry_comparison(params)
    derive_sensor_positioning()
    improve_experiments()

# Thesis Metadata
thesis = {
    "Title": "Data analysis of PIV measurements and CFD simulations on the mixing process in biogas plants",
    "Supervisor": "Bernhard Huber",
    "Institute": "Chair of Regenerative Energy Systems, TUM",
    "Location": "Schulgasse 16, 94315 Straubing, Room 0.A10",
    "Contact": {
        "Phone": "+49 (0) 9421 187-114",
        "Email": "b.huber@tum.de"
    },
    "Earliest Start": "2025-04-01"
}

#Requirements
        # Basic knowledge of Ansys Fluent
        # Advanced programming skills in Python and Matlab

# If you think you are the right candidate to solve this task please contact me.
```