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Use Case

Virtual Sensor Modeling for Oil and Gas Rate

(Well Surveillance-Production)

Virtual Sensor Modeling for Oil and Gas Rate

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Objective

- Well surveillance is essential for reservoir characterization, managing production potential, and selecting activities to enhance production
- Typically, well rates (i.e., oil, water, and gas) are not directly measured all the time, however, with virtual sensors, it is possible to build and implement continuous *well rate estimation* (WRE) or known as *virtual rate estimators* (VRE)
- The relationship of flowing pressure as a function of liquid rate describes the steady-state well performance at any point in time
- This rate estimation requires consistent pressure-volume-temperature (PVT) data, fit-for-purpose production well tests, and reliable sensors

<u>Data Aggregated</u>

Predictors

- Bottomhole pressure (BHP)
- Wellhead pressure (WHP)
- Wellhead temperature (WHT)
- Separator pressure (Psep)
- Separator temperature (TSep)
- Chokes internal diameter (ID_Choke)

Target Variables

- Oil Rate(bbls)
- Gas Rate(bbls)

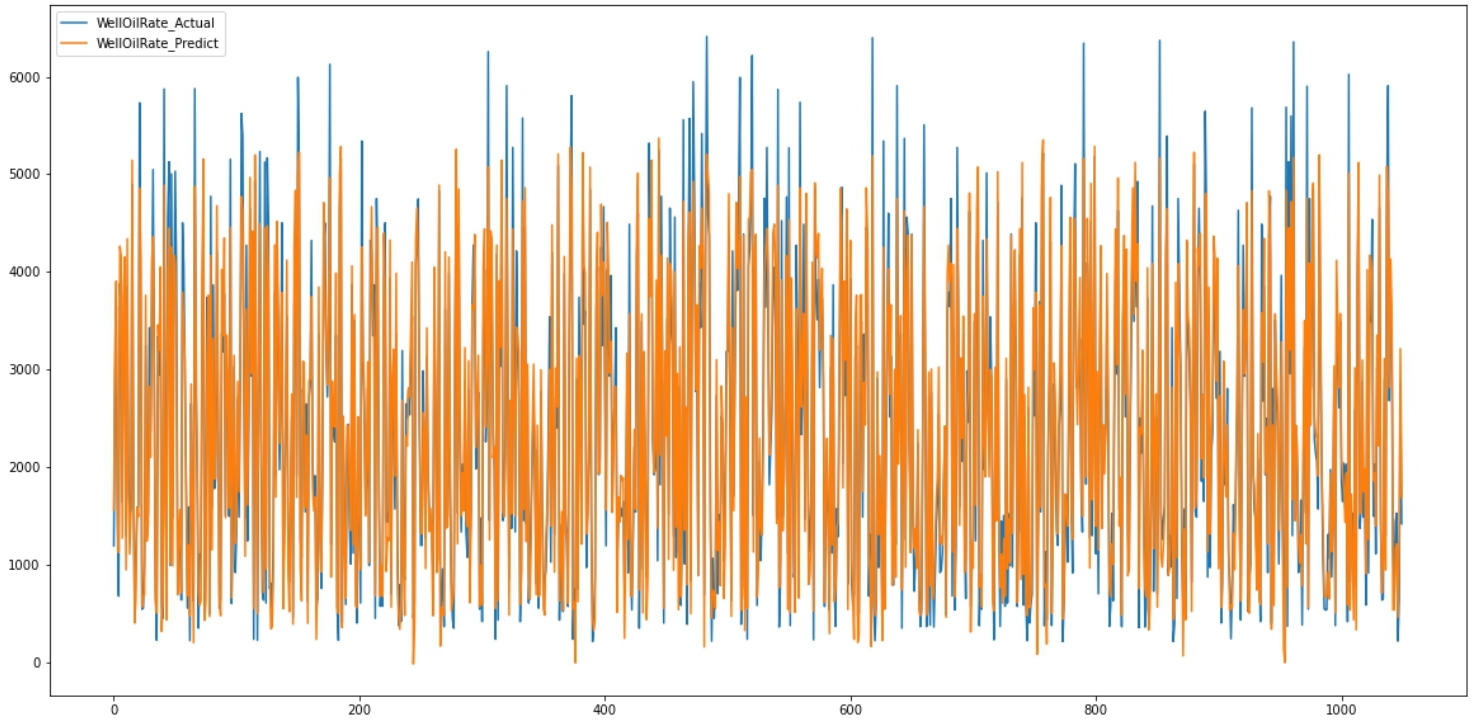
Virtual Sensor Modeling for Oil and Gas Rate

Oil rate

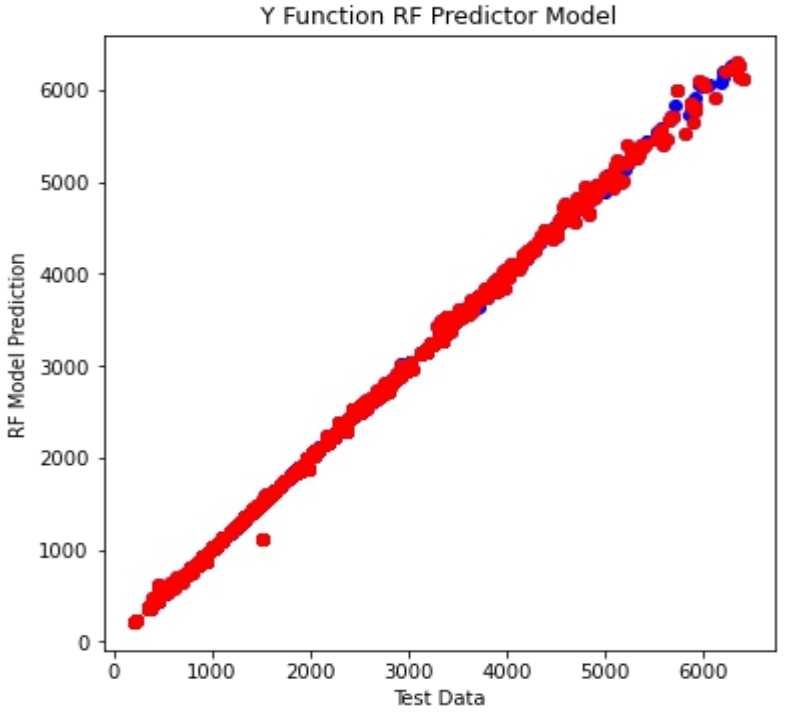
- Linear regression and random forest regressor were used to map the target parameter, Oil rate.
- This soft-sensor can be utilized to monitor the production performance of the well at any point in time.
- This model can be compared with the theoretical capability of the well to produce oil using Darcy's equation.

Model Parameters:
RandomForestRegressor(n_estimators=200,random_state=123)

Model Metrics:
R^2 for test data Random Forest is 0.98
Mean Squared Error for test data Random Forest is 3199.69



Predicted vs Actual Oil Rate



Scatter Plot for Predicted vs Actual Oil Rate

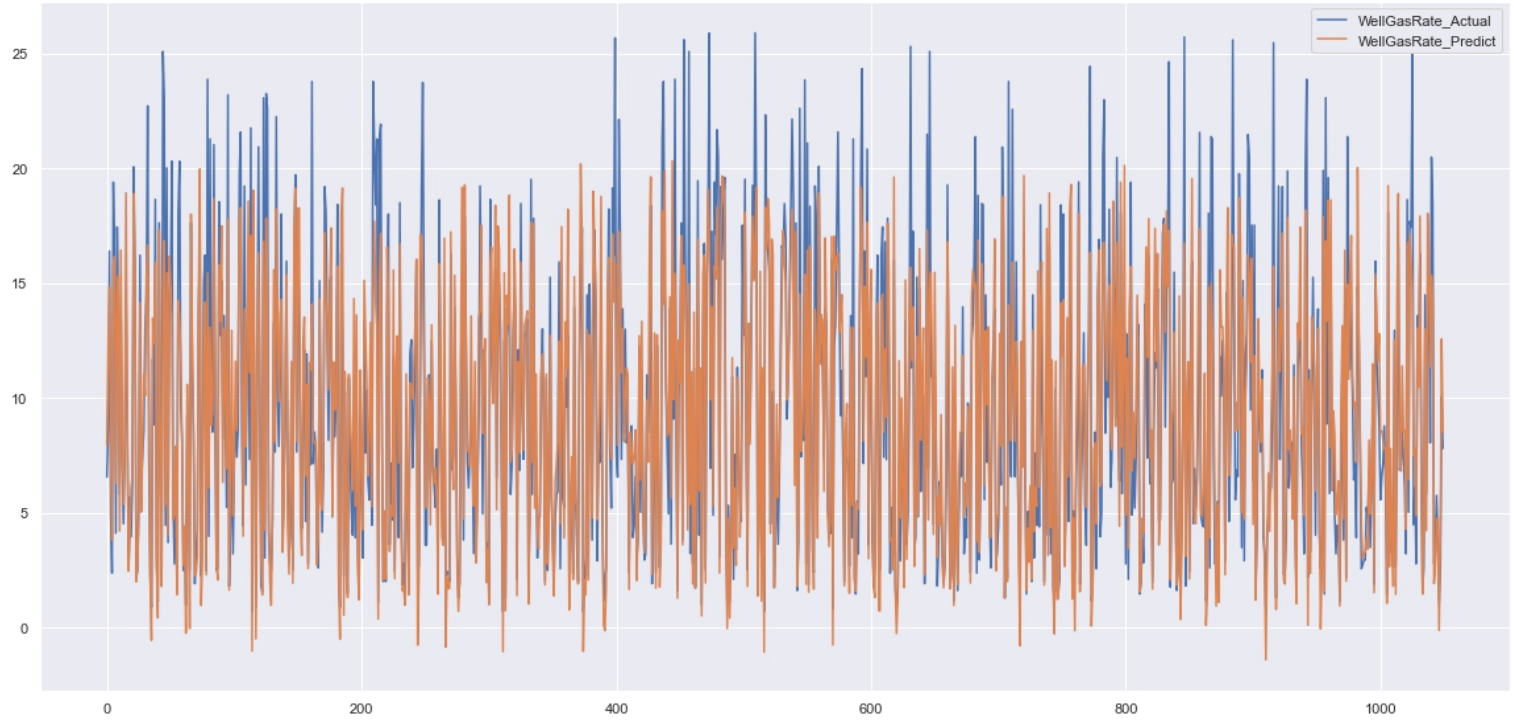
Virtual Sensor Modeling for Oil and Gas Rate

Gas rate

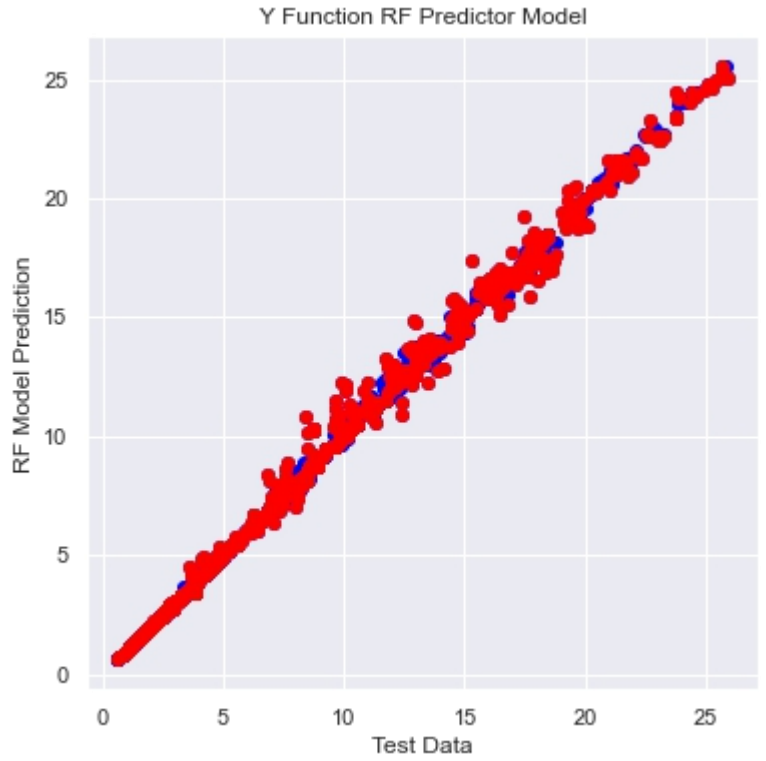
- It is essential to monitor the Oil and Gas rate in the multiphase flow, to estimate the pressure drop along the borewells.
- Linear regression and random forest regressor were used to map the target parameter, Oil rate.
- Appropriate action needs to be taken if any unusual behavior is observed in gas rate.

Model Parameters:
RandomForestRegressor(n_estimators=150,random_state=123)

Model Metrics:
R^2 for test data Random Forest is 0.95
Mean Squared Error for test data Random Forest is 0.1903



Predicted vs Actual Gas Rate



Scatter Plot for Predicted vs Actual Oil Rate