Airfoil Self-Noise prediction

SCS3253 - Machine Learning Project - Group I

Agenda

- Introduction
- Exploration
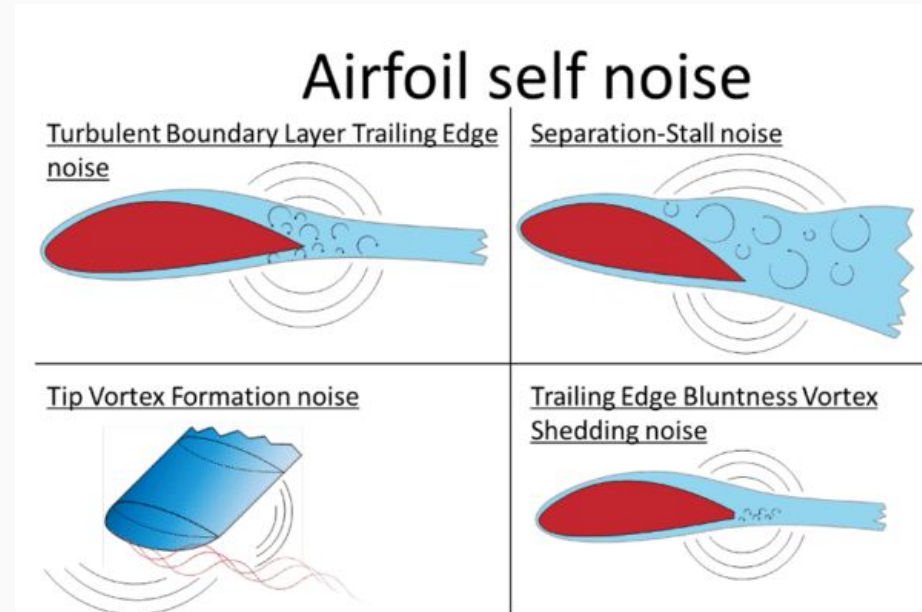- Scikit-learn Models
- Neural network Models
- Summary

Airfoil Self-Noise Dataset

Airfoil Self-Noise Data Set

The NASA data set comprises different size NACA 0012 airfoils at various wind tunnel speeds and angles of attack.

The span of the airfoil and the observer position were the same in all of the experiments.

Airfoil self noise

Turbulent Boundary Layer Trailing Edge noise

Separation-Stall noise

Tip Vortex Formation noise

Trailing Edge Bluntness Vortex Shedding noise

Airfoil Self-Noise Data Set

The NASA data set was obtained from a series of aerodynamic and acoustic tests of two and three-dimensional airfoil blade sections.
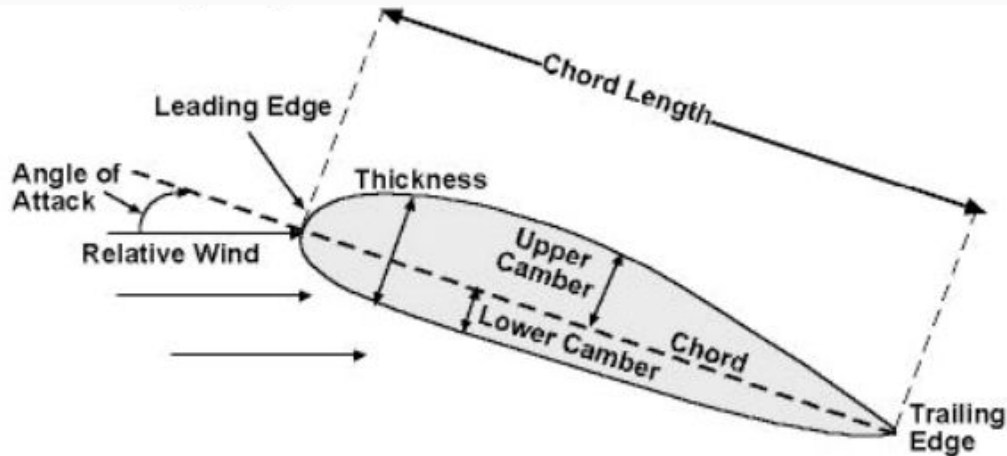
Objective

- Investigating the associations among all features and target.
- Practicing data preprocessing.
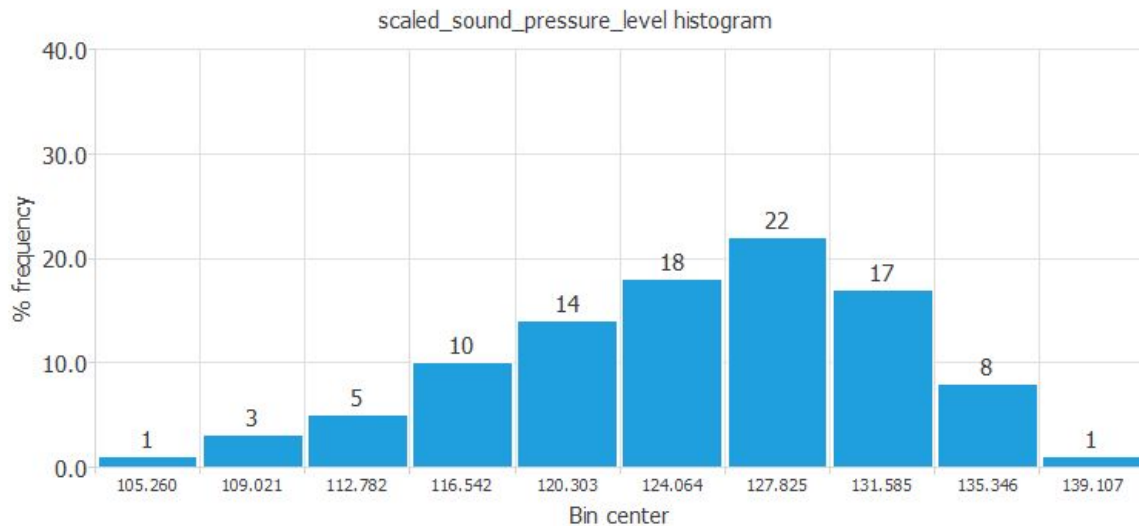- Searching for the better fitting model.

Exploration

Features

There are 5 features and 1 target

The target is scaled sound pressure level, in decibels.

Attribute Information:

1. Frequency, in Hertz.

2. The angle of attack, in degrees.

3. Chord length, in meters.

4. Free-stream velocity, in meters per second.

5. Suction side displacement thickness, in meters.

6. Scaled sound pressure level, in decibels.
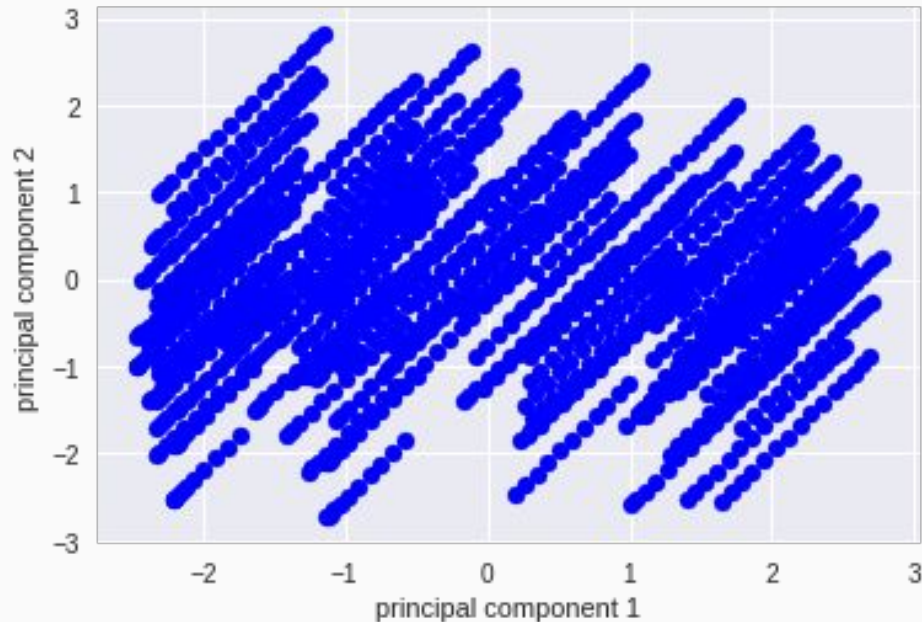
Exploration - target

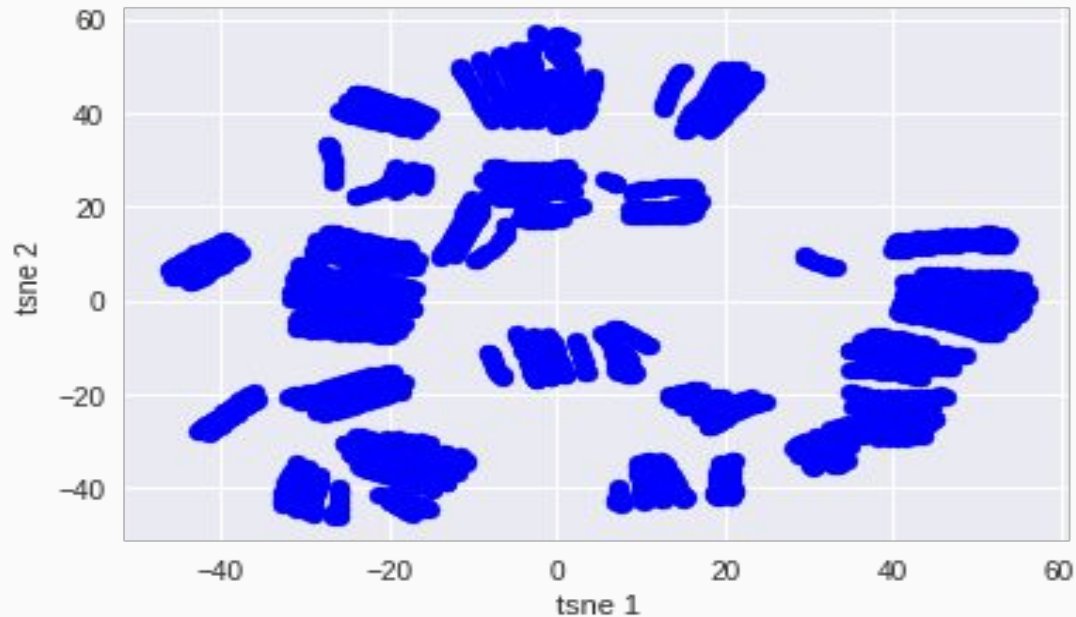# Exploration - features

There are 5 features and 1 target

The target is scaled sound pressure level, in decibels.

Dimensionality reduction - PCA

Dimensionality reduction - T-SNE

Models

Models

- Lasso
- Linear regression
- Neural network
- SVR
- Bayesian Ridge
- Ridge
- ElasticNet

Transformations and tuning

- Quantile transformer: This method transforms the features to follow a uniform or a normal distribution.
- Max Abs scaler: Scale each feature by its maximum absolute value.
- Standard scaler: Standardize features by removing the mean and scaling to unit variance.
- GridSearchCV: Exhaustive search over specified parameter values for an estimator.

GitHub

GitHub page and project

To the code

Results

88%

The best accuracy using a neural network

Results

Model	R2 score	MSE score
Neural network	88.92%	5.40
SVR	79.81%	9.85
BayesianRidge	45.68%	26.52
LinearRegression	45.68%	26.53
Ridge	45.68%	26.52
ElasticNet	45.55%	26.59
Lasso	45.55%	26.59

Thank you