

Motivation:

- More renewables are being incorporated into the power grid today
- With a higher percentage of wind energy we suspect that there will be issues with dynamic stability
- We desire a more realistic model to properly perform dynamic stability analysis

Current Models:

- Minute, hourly, or weekly scaled models
- Used for prediction, cost analysis, and stability analysis
- For dynamic stability, researchers assume a fixed input

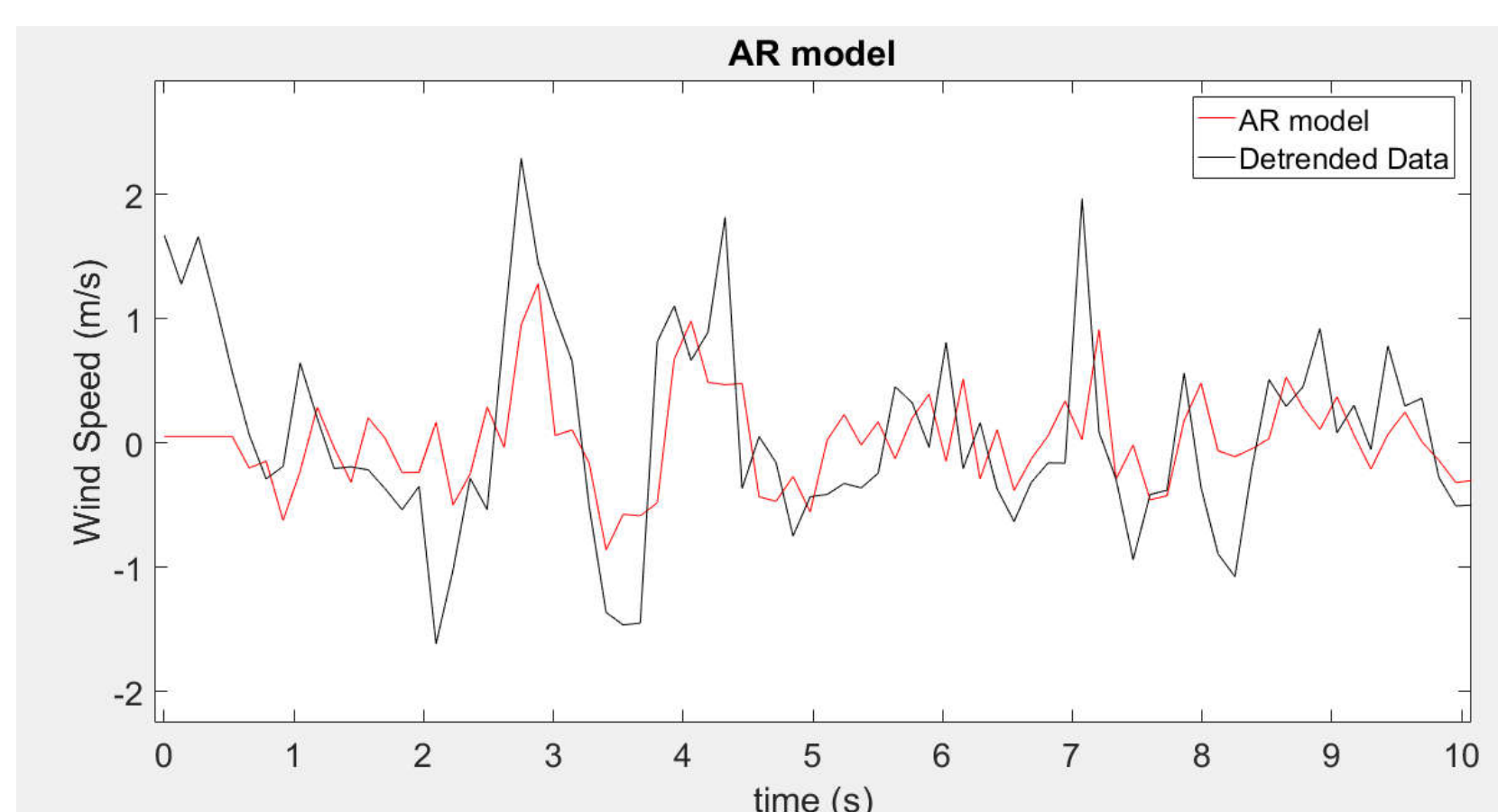
Modeling Wind Speed

Autoregressive Models (AR)

- Relates current value of wind speed based upon previous values of wind speed
- Yule-Walker Equations
 - Relates autocovariance with coefficients ϕ

$$x_t = \phi_1 x_{t-1} + \phi_2 x_{t-2} + \dots + \phi_p x_{t-p} + w_t$$

Equation 1: See citation below

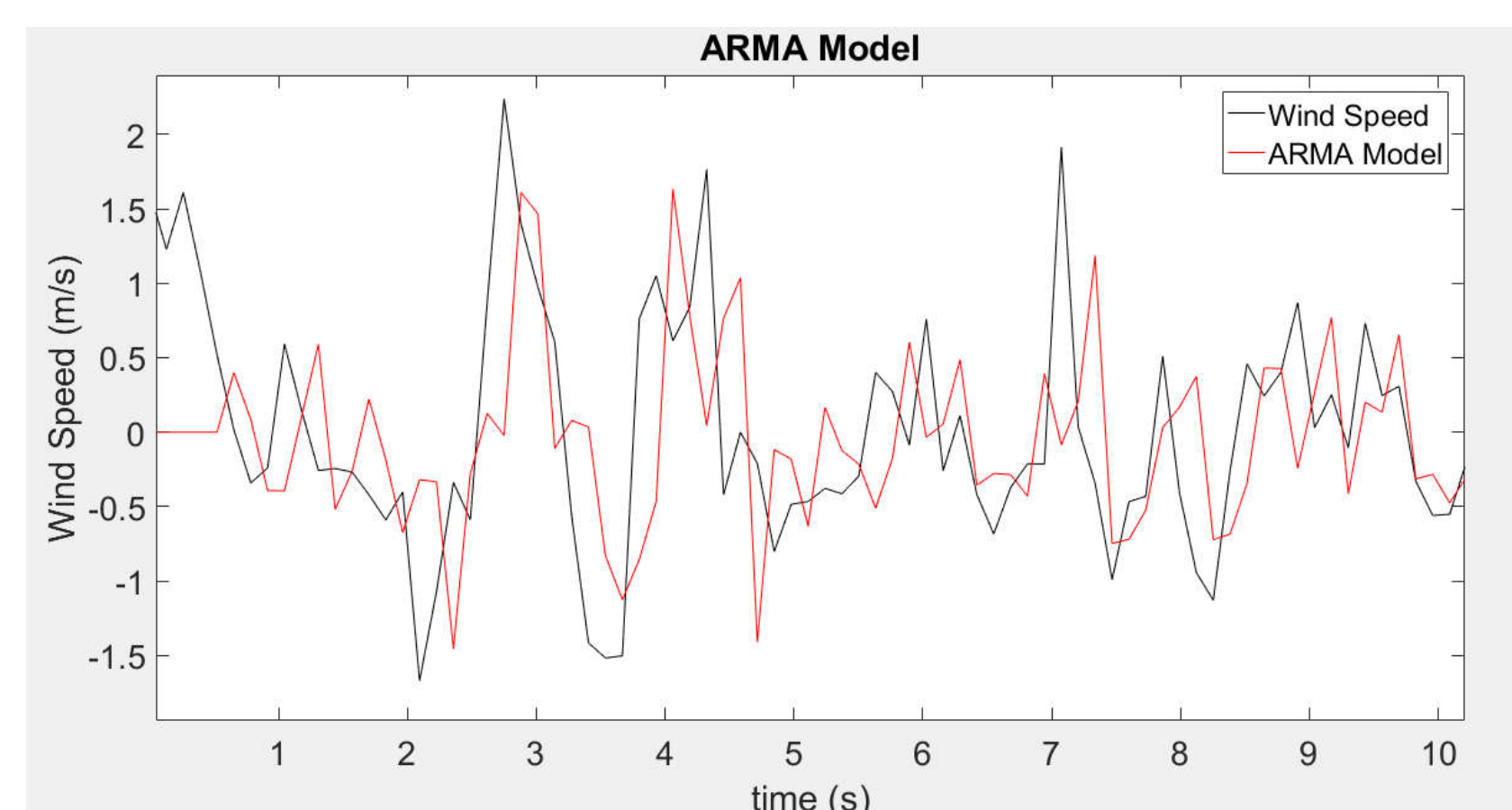


Autoregressive Moving Average Models (ARMA)

- Relates current value of wind speed based upon previous values of wind speed and previous values of white noise
- Durbin-Levinson Equations
 - Relates autocovariance to the coefficients ϕ and θ

$$x_t = \phi_1 x_{t-1} + \dots + \phi_p x_{t-p} + w_t + \theta_1 w_{t-1} + \dots + \theta_q w_{t-q}$$

Equation 2: See citation below



Conclusion and Future Work:

- ARMA model produces a better fit for the wind speed
- We plan to improve the ARMA model to get a better behavior of the wind speed for simulation purposes
- We plan to study the dynamic stability of a system with a high percentage of renewables
 - Oscillations
 - Frequency excursions
 - Impact of wind variability