**Introduction**

GNSS-Reflectometry works as a bistatic radar, in which the transmitter and the receiver are separated by a significant distance, comparable to the expected distance to the target. Its main principle is to receive and further extract information from the GNSS signals reflected off the Earth surface. A typical GNSS-R receiver is placed at the certain distance above the surface can be equipped with two antennas: 1. RHCP antenna (receiving the direct signal) 2. LHCP antennas (reflected signal)

![GNSS-R bistatic radar geometry](image)

**Model**

1. Zavratney Model:

\[
 b(x) = \sum_{\mathbf{m}} \frac{1}{2 \pi} \int \int \frac{H_{\mathbf{m}}(\mathbf{r})}{\sqrt{4 \pi}} e^{i \mathbf{K}_{\mathbf{m}} \cdot \mathbf{r}} e^{-i \mathbf{K}_{\mathbf{m}} \cdot \mathbf{x}} \mathrm{d} \mathbf{r}
\]

- \( \mathbf{r} \): the spatial coordinate on the sea surface
- \( \mathbf{K}_{\mathbf{m}} \): the direction and wave number vector of the \( m \)-th wave number
- \( b(x) \): the scattered signal
- \( \mathbf{H}_{\mathbf{m}}(\mathbf{r}) \): the range dependent wave number function

2. Elfouhaily Model:

\[
 b(x) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \frac{\mathbf{H}(\mathbf{r})}{\sqrt{4 \pi}} e^{i \mathbf{K} \cdot \mathbf{r}} e^{-i \mathbf{K} \cdot \mathbf{x}} \mathrm{d} \mathbf{r}
\]

- \( \mathbf{H}(\mathbf{r}) \): the surface irregularity function
- \( \mathbf{K} \): the frequency modulation function

3. Mean square wave slopes (Elfouhaily, 1997):

\[
 \left\langle \frac{\partial b}{\partial x} \right\rangle = \frac{1}{\pi} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \frac{\mathbf{H}(\mathbf{r})}{\sqrt{4 \pi}} e^{i \mathbf{K} \cdot \mathbf{r}} e^{-i \mathbf{K} \cdot \mathbf{x}} \mathrm{d} \mathbf{r}
\]

**Data**

1. Data collection GPS and BeiDou (GEO – MEO) at Shandong Province. Specification data (Table 1):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DF Frequency</td>
<td>MHz</td>
</tr>
<tr>
<td>DF Frequency</td>
<td>1575.42 MHz</td>
</tr>
<tr>
<td>DF Frequency</td>
<td>1227.60 MHz</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>MHz</td>
</tr>
<tr>
<td>Sampling Rate</td>
<td>10 MHz</td>
</tr>
<tr>
<td>Time</td>
<td>30 s</td>
</tr>
</tbody>
</table>

**Methodology**

1. The Figure 6(a-c) shows the various wind speed of power waveform and different elevation angle and different integration time from real data and MEO model.

2. The results of real and modeled data showed that there have correlation between the power waveform at the different delay offset as the function of the wind speed measurement.

3. The results also provides the relationship between the power waveform at the function satellite elevation with constant wind speed.

4. The power waveform remain sensitive to the wind speed which indicates the possibility of wind speed retrieval with the power waveform obtained in our experimental set up.