CHAPTER 6

GUI AND REAL TIME TESTING OF MODELS
Chapter 6: GUI and Real Time Testing of Models

6.1 Graphical User Interface

Graphical User Interface (GUI) based on the present research is prepared as a stand-alone application which does not require internet connection for its working. By avoiding the web-based GUI, necessity of client side (front end) and server side (back end) is eliminated. The screens and displays of this GUI are seen in the browser like Google Chrome, Firefox are written in HTML (Hyper Text Markup Language). Cascading Style Sheets CSS 3 is used for styling of the pages. Execution of the advanced styling features is managed with help of ‘Bootstrap’ – an open source styling framework. ‘jScript’ is employed for the Java script, which provides asynchronous java script calling.

The GUI is prepared for forecasting wave heights and sea water levels at 24 h horizon. For this purpose, use of either the final ANN or GP Model would have been possible, but owing to the better accuracy of GP Models, respective final GP Models at Station 42040 (Mobile South, AL) and 8410140 (Eastport, ME) are used in the GUI.

Necessary formulas for computing wind shear velocity, its components ($U_*$, $U_*.\cos\theta$ and $U_*.\sin\theta$) and encoded wind directions ($\psi$) from measured wind speeds and wind directions ($U_z$ and $\theta$) are embedded in the GUI. The GUI first forecasts the sea level anomaly for a lead time of 24 h, secondly adds it to the corresponding harmonic tidal level (fed by the user) and lastly displays the answer for sea water level 24 hours ahead of the current time. Of course this happens in a couple of seconds after submitting the required inputs to the GUI.

Therefore inputs required to be fed or submitted to GUI for obtaining wave heights at Station 42040 (Mobile South, AL) at time t+24 using the GUI are: measured speeds and directions of the wind at this station at times t–48, t–36, t–24, t–12, and t. In-built checks for the values fed by user are used in the GUI. Wind speeds must be between 0 and 60 m/s (For hurricanes category 1 through 3 on the Saffir-Simpson hurricane wind scale) while wind directions between $0^{\circ}$ and $360^{\circ}$.

Required inputs to obtain sea water level at Station 8410140 (Eastport, ME) at time t+24 using the GUI are: measured speeds and directions of the wind at this station at times t – 24, t–23, t–22, t–21, t–20, t–19, t–18, t–17, t–16, t–15, t–14, t–13,
t–12, t–11, t–10, t–9, t–8, t–7, t–6, t–5, t–4, t–3, t–2, t–1, t and the astronomical (Harmonic) tidal level at time t+24.

Screen shots of the GUI are shown in Fig 6.1 through 6.3

Fig. 6.1 Opening Screen of the GUI

Fig. 6.2 Wave-Heights Forecast: Page of the GUI
6.2 Real-Time Testing of Models

Real-time testing of the GUI for Significant Wave Height (Hs) and Sea Water level (SWL) forecasts is done using the latest available meteorological data. The data of January 2013 measured at an interval of 1 hour is available at station 42040.

From the corrected meteorological data for wave heights at station 42040 having 1 hour interval, data sets at an interval of 12 hours were extracted for testing the GUI. Quality of wave heights forecast in real-time testing of the GUI at
this station for a lead time of 24 hours is satisfactory as revealed by the wave height plot in Fig. 6.4

![Wave Height Plot: Real Time Testing of GUI](image1)

**Fig. 6.4 Wave Height Plot: Real Time Testing of GUI**

The scatter plot between the measured and forecasted wave heights shown in Fig. 6.5 also indicates an acceptable quality of real time testing of the GUI prepared for wave height forecasts at 24 h horizon at this station.

![Scatter Plot for Wave Heights: Real Time Testing of GUI](image2)

**Fig. 6.5 Scatter Plot for Wave Heights: Real Time Testing of GUI**

Quantitative assessment parameters from the results of GUI shown in Table 6.1 also confirm the acceptability of wave height forecasts in real time mode.

<table>
<thead>
<tr>
<th>TABLE 6.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUANTITATIVE ASSESSMENT PARAMETERS: REAL TIME TESTING OF GUI</td>
</tr>
<tr>
<td>(24 h AHEAD WAVE HEIGHTS AT STATION 42040)</td>
</tr>
</tbody>
</table>
At Station 8410140, corrected meteorological and sea level data sets with 1 hour interval of the year 2013 were used to test the GUI in real time for sea water level forecasts with a lead time of 24 hours. High quality results are revealed by the scatter plot (between the measured and forecasted sea water levels) shown in Fig. 6.6

![Fig. 6.6 Scatter Plot for Sea Water Levels: Real Time Testing of GUI](image)

Since there are as many as 7870 hourly corrected values of sea water levels for year 2013, sea water levels for 4 days are plotted. Almost 100% matching between measured and forecasted water levels is seen Fig. 6.7 for the 4-day plot.

![Fig. 6.7 Sea Water Level Plot for 4-days: Real Time Testing of GUI](image)

Also good quality of forecasts can be confirmed from the quantitative assessment parameters in Table 6.2 (on the next page) for the GUI results in real time mode.
Table 6.2
Quantitative Assessment Parameters: Real Time Testing of GUI
(24 h Ahead Sea Water Levels at Station 8410140)

<table>
<thead>
<tr>
<th>MAE (m)</th>
<th>MSRE (m)</th>
<th>CE</th>
<th>r</th>
</tr>
</thead>
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<tr>
<td>0.101</td>
<td>0.002</td>
<td>0.996</td>
<td>0.998</td>
</tr>
</tbody>
</table>

6.3 Closure

Graphical User Interface (GUI) is prepared for 1-day forecasts of significant wave heights at station 42040 (Mobile South, AL) and sea water levels at station 8410140 (Eastport, ME) using the C++ codes generated by the respective genetic programming models. It works as a stand-alone application and does not require internet connection and is found to produce satisfactory forecasts in real-time mode. After suitable modifications and permissions from the concerned authorities, the GUI can be made web-based and used online.