Design of the Radar for Ocean's Wave Monitoring and Warning System

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Abstract Since 2013, GISTDA has deployed a coastal radar system to monitor the wave heights and directions on the gulf of Thailand. Due to invaluable information provided from the system, GISTDA would like to extend the system to reach Thailand's entire coastline. However, procuring requires an excessive amount of budget. Therefore, they have initiated a program to develop their own system. The aim of this paper is to present the design of their radar station. The details will be given starting from the study of ocean wave detection by radio frequency, RF circuits and antenna design, until the prototype station verification.

Keyword Coastal Radar, Ocean's Wave, Radio Frequency

1. INTRODUCTION

In recent years, Thailand has been affected by numbers of natural disasters, causing loss of lives and setting back economic and social development. Apart from major recurring disasters such as seasonal flood and drought, oceanic disaster and coastal erosion are also the causes of multitude of fatalities.

Consider only the oceanic disasters, the worst tragedy in term of casualties is the 2004 tsunami, caused by the Sumatra-Andaman earthquake, killing over 220,000 people in fourteen countries. Other ocean-related disaster is, for instance, coastal erosion caused by tidal currents and wave currents that leads to the loss of land. Accidents like oil-spill or oil-leakage from the offshore pipelines or oil transport vessel is also affected tremendously the coastal environment.

In order to prevent, assess and minimize the casualty caused by oceanic disaster, a project to deploy a Marine Meteorological Disaster Warning System (MMDWS) was launched by the Meteorological Department of Thailand in 2012.

The key feature of the MMDWS system is the wave-current monitoring system using radio radar technology to measure the wave height and ocean current direction. In the beginning, six wave current measuring stations using high radio frequency range (HF Radar) between 5-30 MHz is utilized. The aim is to remotely measure the ocean wave in the Andaman Sea as well as in the Gulf of Thailand.

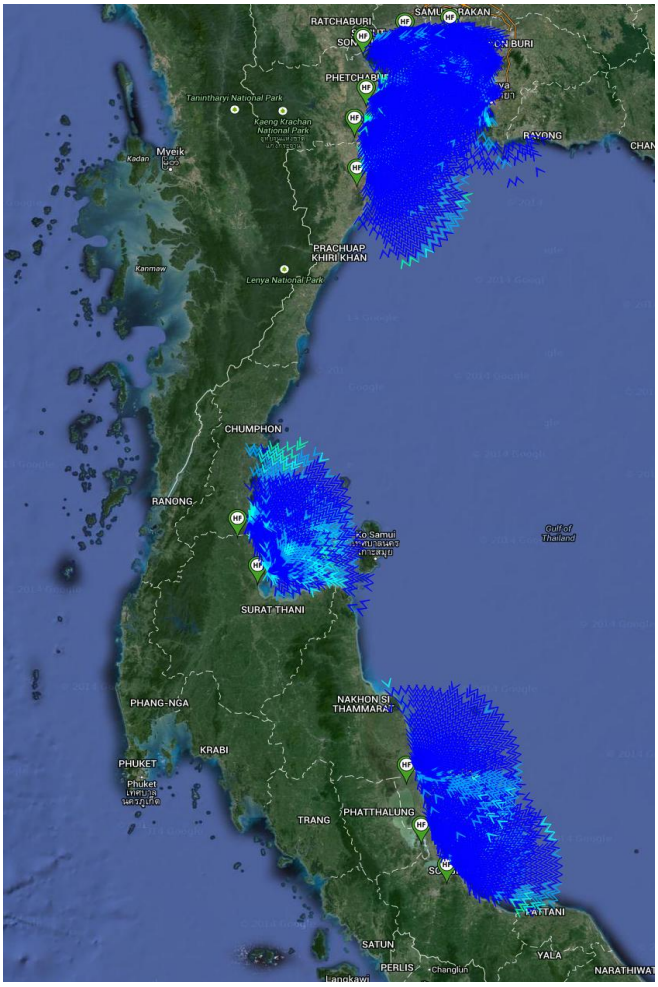

Fig.1. Location of the current Coastal Radar monitoring system.

In 2013, Geo-Informatics and Space Technology Development Agency (GISTDA), under the

supervision of the Ministry of Science and Technology, has deployed a coastal radar system for land and oceanic disaster warning purpose. The main objective are to collect and to distribute information on wave current direction, wave height and wave current speed using both high frequency radar (HF Radar) and X-Band radar.

Currently, 18 coastal monitoring stations consisting of 13 HF radar stations and 5 X-Band stations are installed along the coastline of the Gulf of Thailand. Figure 1 illustrates the locations of the monitoring stations as well as their coverage area [1]. This current coastal monitoring system still relies on imported technology, which involves very high procurement and maintenance cost. Moreover, as the stations are obtained as a complete package, Gistda is unable to modify or improve any of the system.

To reduce cost and to be able to be more self-sustain in terms of technology, Gistda has initiated to develop its own coastal monitoring system. More details are given in the following section.

2. COASTAL RADAR PROTOTYPE DEVELOPMENT

In the first phase of development, the objective of the new coastal radar prototype is designed to be able to detect the sea wave height in the 30 km vicinity of the antenna. This system will utilize 25 MHz (HF band). This frequency is chosen based on the distance of interest requirement. This coastal radar prototype comprises of 4 main components as illustrated in figure 2, which are:

2.1. Antenna. Monopole type is selected in this early development stage since only vertical polarization is required for coastal wave height detection. This type of antenna allows the RF wave to transmit in every direction around the antenna to have the largest coverage area.

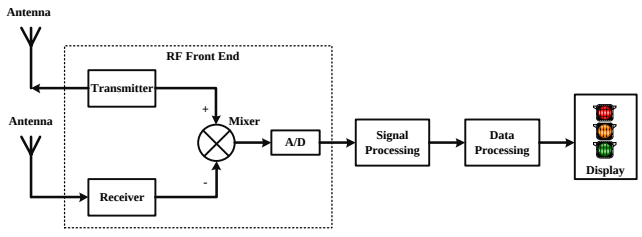

Fig.2. Coastal Radar prototype; System overview.

2.2. RF front-end. The transceiver and receiver for this system will be designed for transmitting and receiving radar pulse waveform reflected from the zone of interest.

2.3. Signal-processing. This component identifies the transmitted and the reflected RF spectrum [2] [3], then determine the distance from the zone of interest, which will be processed to the wave height information in real-time.

2.4. Data logger and display interface. The data from the signal-processing component will be recorded in the computer installed on-site. This data will also upload via internet to Gistda server for monitoring purpose. In addition, a simplified data display panel will be installed on-site to give the real-time coastal wave height information to the public.

From the current development status, this project is envisaged to be finished by the end of 2015.

3. Acknowledgement

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4. References

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