

Utilization of AIS (Automatic Identification System) sensor for mobility monitoring of fishing vessel based on PFZ (Potential Fishing Zones) distribution

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Abstract. Indonesia is known worldwide as an archipelagic country with a vast territory and a country consisting of many islands. The length of the coastline reaches about 81,000 km², so Indonesia is the largest archipelagic country in the world with two thirds of its territory consisting of oceans. One of the efforts that need to be conducted is to improve the economy and accelerate the development of the marine sector. With this policy, the security of marine and marine resource management is very important. Exclusive Economic Zone (EEZ) and continental foundation are vital areas that need to be guarded and guaranteed for the benefit of maritime sovereignty of the Republic of Indonesia. The development of science and technology of remote sensing, LAPAN in cooperation with IPB to make satellite LAPAN / IPB-A3 or A3LISat. These satellites serve as monitoring of paddy field resources. These satellites are orbiting 14 times a day in the territory of Indonesia is equipped with AIS (Automatic Identification System) sensor where the sensor is to monitor the mobility of the ship. The AIS sensor can provide location coordinate information and temporarily obtain ships vessel information in Indonesian seas. This research tried to utilize the AIS sensor and combined with PFZ (Potential Fishing Zone) information result of remote sensing data and analyzes the mobility of fishing boats recorded by A3 satellite whether it is in accordance with the PFZ information extracted from remote sensing satellite LISat data.

1. Introduction

[1] National Institute of Aeronautics and Space (LAPAN) is always working to improve product quality and information technology in the field of aviation and space to create an advanced and independent Indonesia. LAPAN effort is to bring technology is satellite LAPAN A2 and A3 (LISAT) LAPAN IPB Satellite. The satellite is fully the result of work of the nation and made in Indonesia. The objective of LAPAN-A2 satellite project is to achieve the design, integration and operation of micro satellite in Indonesia. LAPAN-A2 main mission is Earth Observation (video/matrix RGB camera surveillance). In addition to that the satellite carry AIS (Automatic Identification System) receiver to monitor maritime traffic, a reaction wheel made by LAPAN (LPN-001) for space proofing, and an amateur radio Automatic Packet Reporting System (APRS), as well as amateur radio voice repeater, for Indonesian Amateur Radio Organization (ORARI).

[2] The LAPAN-A3/IPB, also referred to as LISat, is a cooperative remote sensing microsatellite project between LAPAN (National Institute of Aeronautics and Space of Indonesia) Jakarta and IPB (Bogor Agricultural University or Institute Pertanian Bogor) located in Bogor, Indonesia. LAPAN-



A3/IPB was launched on June 22, 2016 (03:56 UTC) as a secondary payload (piggy back) to ISRO's CartoSat-2C spacecraft. The launch site was SDSC (Satish Dhawan Space Center) in India and the launch vehicle is PSLV-C34. Orbit of LAPAN A3 satellite are Sun-synchronous circular orbit, altitude = 515 km, inclination = 97.5°, local time on descending node (LTDN) = 9:30 hours. The LAPAN-A3/IPB mission, this polar sun-synchronous orbit will make about two times contact per day (day and night) of about 11 minutes average. In this limited contact scenario, much of data will be downlinked in near real time to the ground station through - band communication link that contain the information of data imagery and shipping monitoring data as well.

[3] LAPAN-A3 satellite brings a multispectral imager as main payload which has four color channel, i.e.: red, green, blue and near-infrared. The imager optics system uses beam-splitter mechanism, which divides the incoming light passing lens system into each color channel detector.

This research is to utilize the information of fishing vessel data obtained from AIS sensor and combined with PFZ information resulted from remote sensing data utilization. This study analyzes the mobility of fishing vessels recorded by LAPAN A2 and A3 satellite. The mobility of the fishing vessel is appropriate, knowing and utilizing the PFZ (Potential Fishing Zone) information.

2. Research Background

[4] The importance of the maritime sector in Indonesia has been known for a long time, even long before the Republic of Indonesia was formed, when it was still in the form of small kingdoms with their respective interests in each region. In development in the marine sector in various aspects, one of which is increasing the catch of fish with fishing vessel . [5] The main problem of optimizing fish catch especially pelagic fish is the very limited data and information about oceanographic condition which is closely related to fishing potential area. Identification of potential fishing areas using remote sensing technology is an indirect means of identification. From remote sensing data, identification of oceanographic parameters that are closely related to fish habitat or areas that are suspected of potential place for fish, such as the occurrence of thermal front or upwelling. This technology is known as PFZ (Potential Fishing Zone).

[6] The Automatic Identification System (AIS) was developed to provide identification and location information to vessels and shore stations with the aim of exchanging different types of data including position, identification, course, speed and others. On one hand this allows vessels to anticipate and thus avoid collisions at sea by means of continuous traffic monitoring with several navigation aids, while on the other hand, AIS also offers important ship monitoring services to coastal guards as well as search and rescue organizations.

One of the LAPAN-A2 and LAPAN-A3 missions is maritime traffic monitoring using AIS. AIS information can be used to analyze the distribution of fishing vessel and potential fishing zone. [8]The benefits of AIS (Automatic Identification System) can be used for An Oil Spill Tracking Application.

3. Research Method

To utilization of AIS sensor for mobility monitoring of fishing vessel based on PFZ distribution, there are two kinds of material. Primary data for LAPAN A2 and A3 satellite data with our AIS and secondary data information using data vector for administrative Boundary of Indonesia.

Table 1. Material Research

	Data	Period	Location
Primary Data	LAPAN A2 and A3	Jan-Des 2016 and Jan-May 2017	Indonesia
Secondary Data	Vector Data: Administrative Boundary	2015	Indonesia

The selection of data period for LAPANA2 and A3 satellites is the last 1.5 years from this research period, expected to know the condition of Indonesian waters at this time.

[6] For LAPAN-A2 Satellite, AIS data is downloaded using Biak Ground Station, which is equipped with 11 meter S-Band (2220MHz) antenna. The downloaded file is stored in a binary format and uploaded to a cloud server. The Bogor Ground Station downloaded the file for extraction and processing. The processed data produce ship information such as geolocation, time, and other properties, presented in a text file. Workflow of the system LAPAN A2 can be described as shown in the picture below in figure 1.

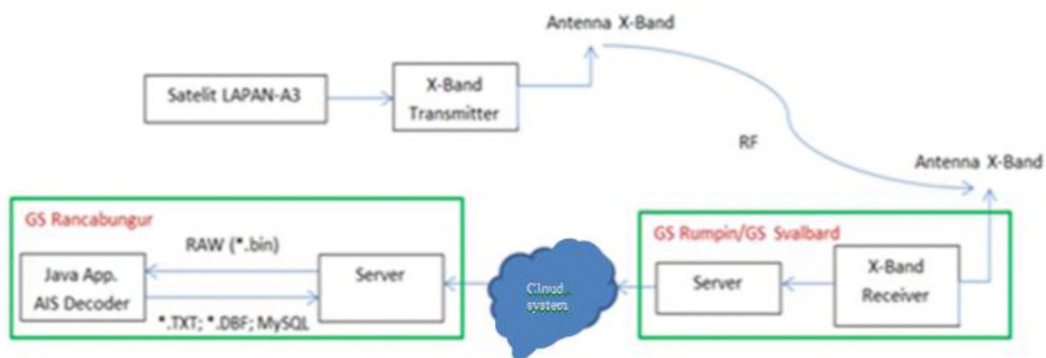


Figure 1. Workflow Process Downloaded LAPAN-A2 Information

The operations are carried out in the development includes:

- Modules to read the AIS raw file. It is tasked to locate the frame starting point, frame ending point, and calculate the size of the frame. Each frame contains dozens of AIS data.
- Modules to locate the code word that represents single data lines, which identify the AIS data.
- Modules to perform CRC16-CCITT calculation and distinguish between bad CRC16-CCITT (represented by 1) and good CRC16-CCITT (represented by 0).
- Modules to perform decoding of all the data according to its respective code word.

[7] For LAPAN-A3 Satellite, AIS data is downloaded using Svalbard Ground Station in Norway. The station is also equipped with 11 meter X-Band (8200 MHz) antenna. The file is stored in binary format and uploaded to a cloud server. The Bogor Ground Station downloaded the file for extraction and processing. The processed data produce ship information such as geolocation, time, and other properties, presented in text file. Workflow of the system LAPAN A3 can be described as shown in the picture below in figure 2.

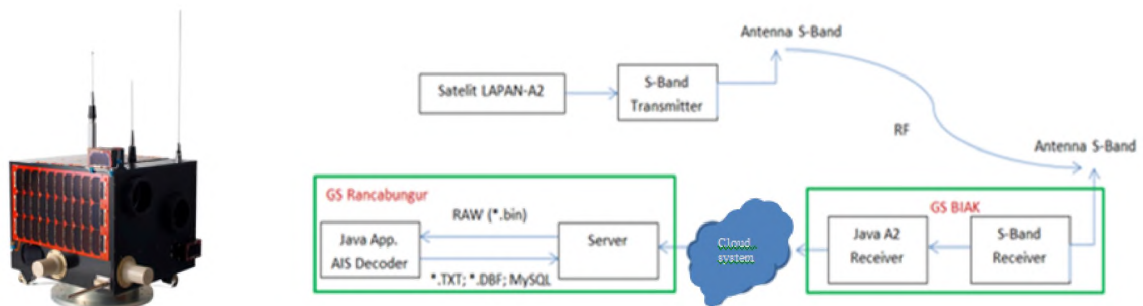


Figure 2. Workflow Process Downloaded LAPAN-A3 Information

The operations are carried out in the development includes:

- a. Modules to read the AIS raw file and remove the CCSDS format (header and parity). It is roled to locate the frame starting point, frame ending point, and calculate the size of the frame. Each frame contains dozens of AIS data.
- b. Modules to locate the code word that represents single data lines, which identify the AIS data.
- c. Modules to perform CRC16-CCITT calculation and distinguish between bad CRC16-CCITT (represented by 1) and good CRC16-CCITT (represented by 0).
- d. Modules to perform decoding of all the data according to its respective code word.

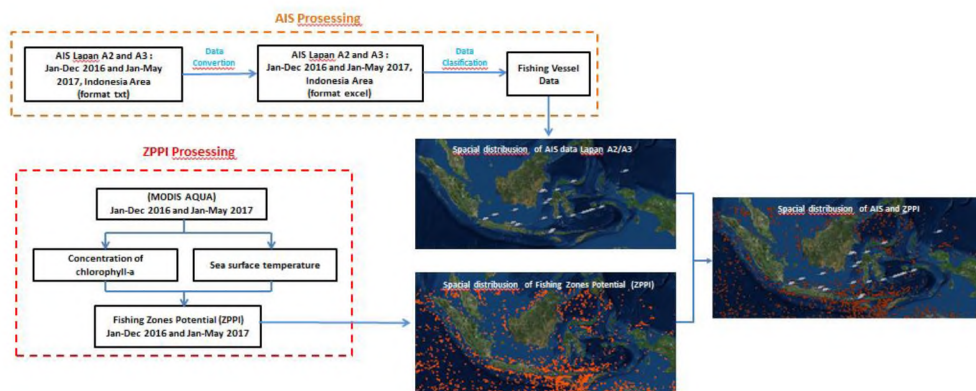


Figure 3. Mapping Flow AIS and PFZ

In Figure 3 mapping flow AIS with PFZ. The AIS data on the classification of the fishing vessel is subsequently displayed spatially so that the distribution is visible. The results are then combined with potential fishing zone (PFZ) data to determine the distribution of fishing vessels are appropriate or not appropriate to PFZ. Data PFZ is extraction of chlorophyll-a concentration and sea surface temperature. PFZ data obtained from weather satellites MODIS AQUA from January to December 2016 and January to May 2017.

4. Result

AIS LAPAN A2 / A3 data provides information on recording time, MMSI (Maritime Mobile Service Identity), navigation, and location. Information MMSI is a series of 6-9 digit numbers sent in digital data through a radio frequency channel with the purpose of being the unique (unique) identity of a ship to the ship station. MMSI information describes ship name information and ship size according to MSSI database. Navigation information describes ship activity and ship type. Location information is the coordinate location information when the data is recorded by satellite. This data is very important because as a reference in knowing the distribution of ships in Indian Ocean.

Based on AIS LAPAN A2/A3 data of 2016 and 2017, the distribution of fishing vessels tends to focus on Indonesian eastern waters, around Banda Sea and Timor Sea. Fishing vessels spread across the Java Sea, Makassar Strait, Celebes Sea, Molucca Sea, Banda Sea, Flores Sea and Halmahera Sea.



Figure 4. Result Mapping AIS and PFZ

5. Conclusion

After plotting with PFZ data, the analysis showed that not all fishing vessels are in fish potential location. There are several ships on the high seas and there are also ships that are leaning on the harbour. AIS LAPAN A2/A3 data is very helpful in identifying and monitoring the fishing vessel. Fishing vessel information can be determined using this AIS data, but only on the level of ship type identification. AIS data has not been able to provide information up to the level of ship activity when at a recording location, such as loading and unloading of goods, illegal fishing and illegal oil transactions. To be more accurate the activity information can be supported with ground check data.

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