Instructions for the use of sea-detecting radar data

The sea-detecting radar data is based on the **"The sea-detecting data-sharing program"** proposed and implemented by Associate Professor Liu Ningbo of the Naval Aviation University. It aims to use the X-band solid-state full-coherent radar to conduct sea-detecting experiments in batches, and obtain sea clutter and target data under the condition of different sea states, resolutions and grazing angles, and synchronously obtain real data of marine meteorological hydrological data, target position and trajectory. The purpose is to construct a sea clutter dataset with full information record and promote the research of sea clutter cognition and suppression, target detection and recognition technology.

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The following is a description of **MAT data (radar data)** and **NC data (meteorological hydrological data).**

Instruction of MAT data (radar data) (20191020)

1. After loading (such as load in MATLAB) MAT data, there are three variables (matrix): amplitude_complex_T1, amplitude_complex_T2, and amplitude_complex_info.
2. The data headers are stored in the amplitude_complex_info variable. Each row (the length is 48) is the data header of a pulse echo. The meaning of each information bit is shown in the following table. Each row of the amplitude_complex_info variable corresponds to each of the two variables of the amplitude_complex_T1 and the amplitude_complex_T2.
3. If the radar works in scanning mode, the data stored in amplitude_complex_T1 and amplitude_complex_T2 is one full scanning cycle (360°); if the radar works in staring mode, the echo data of several pulses (such as 100,000 or 200,000, etc.) are stored in the amplitude_complex_T1 and amplitude_complex_T2 variables.

4. The amplitude_complex_T1 is the echo of the T1 pulse (single carrier frequency transmitting signal) (zero intermediate frequency complex data composed of I and Q), and the data representation is a matrix. For data in scanning mode, take 7369×1320 as an example, 7369 corresponds to pulse/azimuth dimension, and 1320 corresponds to distance dimension; for data in staring mode, take 10000×1320 as an example, 10000 corresponds to the pulse/time dimension, and 1320 corresponds to the distance dimension.
5. Amplitude_complex_T2 is the echo of the T2 pulse (LFM transmitting signal) (zero intermediate frequency complex data composed of I and Q), and the data representation is a matrix. For data in scanning mode, take 7369×5250 as an example, 7369 corresponds to pulse/azimuth dimension, and 5250 corresponds to distance dimension; for data in staring mode, take 10000×5250 as an example, 10000 corresponds to pulse/time dimension, and 5250 corresponds to the distance dimension.

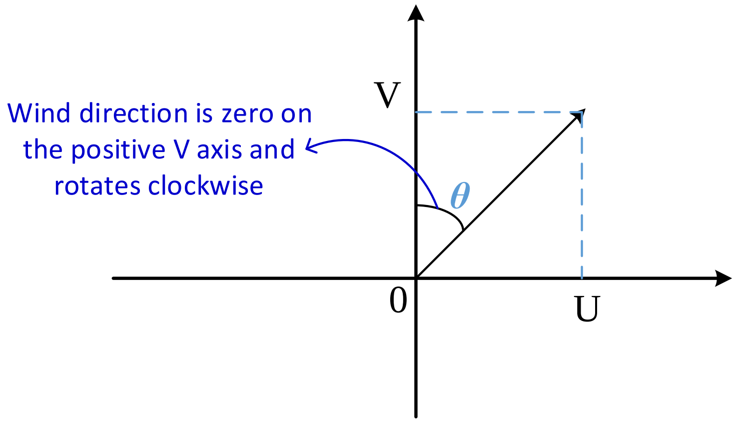
number	**The meaning of the data header**	**Value description**
1.	Header length	The value is 48, fixed
2.	T1 (single carrier frequency) pulse width	μs
3.	T1 pulse echo sampling points	
4.	T2 (LFM) pulse width	μs
5.	T2 pulse echo sampling points	
6.	T3 (LFM) pulse width	μs, Take 0 to indicate that no T3 is transmitted.
7.	T3 pulse echo sampling points	Take 0 to indicate that no T3 is transmitted.
8.	Direction code	Quantified to 5120 parts with 360°
9.	Azimuth	°
10.	Distance sampling rate	MHz
11.	Distance corresponding to the first sampling point of the T1 pulse echo	km
12.	T2 pulse echo corresponding distance of the first sampling point	km
13.	T3 pulse echo corresponding distance of the first sampling point	km
14.	Beijing time (UTC time) (take the value directly read from data header as UTC_time)	Indicates the number of seconds *100 relative to 0 o'clock. The method of conversion to hours and minutes: Time_second=mod(UTC_time, 60 * 100) / 100; % Take seconds, with 2 decimal places Time_minute=mod(UTC_time-time_second * 100, 3600 * 100) / 60 / 100; % Time_hour = (UTC_time - time_minute * 60 * 100 - time_second * 100) / 3600 / 100; % Take the hour
15.	Radar latitude value (N) (take the value directly read from data header as LAT_ORIG)	The method of conversion to degrees and points: Lat_minute = mod(LAT_ORIG, 60 * 10000) / 10000; % Take the latitude score with 4

		decimal places Lat_degree = (LAT_ORIG - lat_minute * 10000) / 60 / 10000; % Get the degree of latitude
16.	Radar longitude value (E) (take the value directly read from data header as LON_ORIG)	The method of conversion to degrees and points: Lon_minute = mod(LON_ORIG, 60 * 10000) / 10000; % Take the longitude score with 4 decimal places Lon_degree = (LON_ORIG - lon_minute * 10000) / 60 / 10000; % Take the degree of longitude
17.	Radar platform speed	m/s
18.	Radar platform heading angle	°, standing for the angle between the ship and the north
19.	Radar range	nm
20.	Launch control	Take 0：Current orientation does not emit Take 255：Current azimuth emission
21.	STC control	Take 3: turn off STC Take 0/1/2: turn on STC
22.	Scanning method	Take 198: staring, take 0: 24r/min, take 12: 12r/min, take 3: 6r/min, take 6: 2r/min
23.	Shield starting angle	°
24.	Shield end angle	°
25.	Radar azimuth correction angle	Adjust the radar azimuth to 0 °to the north, this value is related to the radar setting up. Once set, it does not changed, The azimuth at the 9th information bit has been considered in the calculation process.
26.	Pulse repetition frequency (PRF)	Hz
27～48	Reserved information bit	Alternate, default is 0

NC data (meteorological and hydrological data) description (20191020)

1. **Wind element data**, such as wind_info.2019101200, records wind element data at a height of 10 meters above sea level. The time is from 0:00 on October 12, 2019 to 0:00 on October 13, 2019, and is updated once every 15 minutes. , a total of 97 time points.

   Reading method: In MATLAB data path, use ncinfo function to display data information, such as ans=ncinfo('wind10m.2019101200.nc'), ans.Variables shows all the variables contained in the data file, which are Times (Time, updated every 15 minutes), U10 (wind speed horizontal component), V10 (wind speed vertical component), latitude, longitude. To read a variable data, use the ncread function. Such as ncread(‘wind10m. 2019101200.nc’,’U10’), ncread(‘wind10m.2019101200.nc’,’ V10’). The wind speed calculation formula is $\sqrt{(U10)^2+(V10)^2}$, and the wind direction is calculated as the angle θ in the figure below. In particular, wind direction is defined as the direction the wind comes from, i.e. the south wind means the wind blows from south to north.



2. **Wave element data,** such as wave_info_2019101200.nc, records the wave element information. The time is from 0:00 on October 12, 2019 to 0:00 on October 13, 2019, and is updated once every 15 minutes for a total of 97 time points.

   Reading method: In the data path of MATLAB, the data information can be displayed by ncinfo function, such as ans=ncinfo('wave_info_2019101200.nc'), all variables contained in the data file are displayed in ans.Variables, i.e. lat (latitude)), lon (longitude), t (time), HS (effective wave height), DIR (average wave direction), T01 (average period), velocity (dominant wave speed). The ncread function can be used to read a certain variable data, such as ncread ('wave_info_2019101200.nc', 'HS'), ncread ('wave_info_2019101200.nc', 'DIR').