TABLE 2-continued

Processs_Directional Flow	
Calc_Equations	Calculates values needed for further processing of wave data.
↓	
Save_Results	

The algorithm is used shoreside and within the on-board processing (see Routine name Noise Correction). In the on-board processing, it is used to determine the lowest frequency at which to start the integration of the angular rate measurements to determine pitch and roll.

C11M(f(n)): Acceleration spectral density for a frequency, f(n), where n presents the index of the frequency band. For the DDWM, n={0:46}.

The Noise Correction for each frequency band (NC(f(n))) is computed as follows:

$$NC(f(n))=20*C11M(f(n=0))*(0.18-f(n)),\ \text{for } NC(f(n))>=0;$$

$$NC(f(n))=0,\ \text{for } NC(f(n))<0;$$

NC(f(n)) is then subtracted from each C11M(f(n)). If the result of the subtraction is less than zero, then the result is set to zero.

The advantages of the invention over other wave measuring systems are the adjustments and corrections of the spectra. In many cases, these adjustments and corrections complicate the processing and are not considered cost-effective measures. These adjustments and corrections elevate the invention's measurements to more exacting precision and accuracy than if they were ignored.

As noted in the Background of the Invention, the Prior Art of Middleton, while providing directional wave spectra, does not provide a means for filtering out acceleration data noise. The present invention provides an algorithm that uses the VLF signals to estimate acceleration data noise and to automatically identify the cut-off frequency for starting integration of angular rate measurements. Thus, the present invention, provides a number of improvements over the apparatus and methods of the Prior Art, including more accurate & less noisy measurements due to the unique algorithms disclosed herein, and the entire system which, together, provide a more affordable and deployable capability than others have achieved in terms of less costly/bulky/compact.

While the preferred embodiment and various alternative embodiments of the invention have been disclosed and described in detail herein, it may be apparent to those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope thereof.

We claim:

1. A system for measuring spectra of surface ocean waves in near real-time comprising:

a discus-shaped buoy floating at the ocean surface and moored to the seafloor, the discus-shaped buoy moving in response to wave action;

buoy motion sensors, mounted to the buoy, for measuring vertical acceleration and angular rate of the buoy;

a wave processing system, coupled to the buoy motion sensors, for converting vertical acceleration and angular rate into pitch and roll measurements of the buoy and generating wave spectral data from the pitch and roll measurements of the buoy, the wave processing system correcting vertical acceleration measurements to compensate for angular rate of the buoy; and

a telecommunications relay system, coupled to the wave processing system, for transmitting wave spectral data to a shoreside processing system, the shoreside processing system processing the wave spectral data to remove noise from the wave spectral data and disseminating processed wave spectral data to users,

wherein the shoreside processing system corrects noise for at least one frequency band, where:

C11M(f(n)) is the acceleration spectral density for a frequency, f(n), where n presents the index of the frequency band; and

The Noise Correction for each frequency band (NC(f(n))) is computed as follows:

$$NC(f(n))=20*C11M(f(n=0))*(f(n)-0.18),\ \text{for } NC(f(n))>=0;$$

$NC(f(n))=0$, for $NC(f(n))<0$; and

NC(f(n)) is then subtracted from each C11M(f(n)) and if a result of the subtraction is less than zero, then the result of the subtraction is set to zero.

2. A system for measuring spectra of surface ocean waves in near real-time comprising:

a discus-shaped buoy floating at the ocean surface and moored to the seafloor, the discus-shaped buoy moving in response to wave action;

buoy motion sensors, mounted to the buoy, for measuring vertical acceleration and angular rate of the buoy;

a wave processing system, coupled to the buoy motion sensors, for converting vertical acceleration and angular rate into pitch and roll measurements of the buoy and generating wave spectral data from the pitch and roll measurements of the buoy, the wave processing system correcting vertical acceleration measurements to compensate for angular rate of the buoy; and

a telecommunications relay system, coupled to the wave processing system, for transmitting wave spectral data to a shoreside processing system, the shoreside system processing the wave spectral data to remove noise from the wave spectral data and disseminating processed wave spectral data to users,

wherein said buoy motion sensors comprise at least one accelerometer aligned with the buoy's vertical axis, three orthogonal angular rate sensors, and three orthogonal magnetometers and,

wherein the wave processing system determines buoy orientation with respect to True North from measurements of Earth's Magnetic flux by the three orthogonal magnetometers, pitch and roll information from the angular rate sensors, corrections for the buoy's hull and electronic effects, and the magnetic declination at the buoy's location and wherein the wave processing system determines wave direction from pitch and roll data relative to buoy orientation with respect to True North.

3. The system of claim **2**, wherein the wave processing system uses Fast Fourier Transforms (FFTs) to transform the acceleration and angular rate data time domain into the frequency domain providing Fourier coefficients at discrete frequencies.

4. The system of claim **3**, wherein the wave processing system band averages the Fourier coefficients of adjacent discrete frequencies of the wave spectrum to reduce data volume transmitted to the shoreside processing system.

5. The system of claim **4**, wherein the wave processing system transforms band-averaged Fourier coefficients into a set of directional wave parameters in terms of spectral density, directions, and spreading functions of the waves using a predetermined algorithm.