

Creating and operation of the ocean acoustics calculation Website

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Sound speed and absorption in seawater are considered to be basic and important factor to design the SONAR. The author creating and operation on the Internet Website (<http://www.tsuchiya2.org/>) that could easily calculate sound speed and absorption (propagation loss) in seawater by PHP¹ which was kind of the web script language. As equations of the sound speed of the seawater, Mackenzie², Coppens³, Del Grosso⁴, UNESCO (Chen & Millero)^{5,6} were used. As an equation of the absorption, Thorp⁷, Shulkin & Marsh⁸, Fisher & Simmon⁹, Francois & Garrison^{10,11}, Ainslie & McColm¹² were used. In this site, the value of each equation is calculated with a web-server by a user inputting the DTS (depth, temperature, salinity), frequency and PH from a WEB browser of client. The calculation result is output through the Internet by a web-browser of a client. In addition, sound speed and the absorption (propagation loss) profiles of the depth direction are calculated by a client's uploading a DTS (CSV) file in this site.

1. The construction of the calculation Website by the WEB programming

The programming language of the compiler type such as FORTRAN, C, BASIC has been used for the numerical computation of the field of ocean acoustics. However, a unique compilers to each compiler language is required. Because the language of the compilation type could not support OS version up and a high-performance CPU, it was often assumed that a re-compilation was impossible. On the other hand, WEB programming language (Java, Perl, Ruby, etc) using the Internet is an interpreter-type language. Because a calculation site is built to WEB server, in this language, the calculation is carried out through the browser of the client. Therefore a compiler is not required, and the user does not mind the difference of the OS and the CPU. In addition, there is advantage that all the Internet users are available when a calculation site is release. In this study, possibility of the WEB programming attracted attention, and, in the WEB calculation site that could demand the sound speed and absorption losses in seawater which was the ocean acoustics most basic element, it was creating and operation on the Internet. The main purpose PHP language processing used in this study is to realize dynamic WEB page by generating HTML data. PHP works on WEB server and can describe a direct cord in an HTML file. Therefore, a program of PHP which was described in a document whenever the document on the server is required is carried out, and the result is transmitted to a Web-browser. Because the data transmitted to PHP are HTML, PHP works by all browsers used by the main OS's such as Unix system, MS Windows and the Mac OS. PHP is an open source. Therefore, the introduction of PHP is carried out easily by installing free modules such as xampp in web-server using Apache or IIS.

2. Calculation program in the ocean acoustics

2.1. Sound speed calculation program in seawater

The sound speed in the seawater of most basic parameter is used for a distance measurement such as echo sounders (PDR) or the ocean acoustic tomography observation. The equation of the speed of sound in seawater is expressed as a volume coefficient of elasticity and relations of the density of the seawater. The sound speed equation (an empirical formula) has been proposed for function of temperature (deg C), Salinity (ppt) and a the depth(m) or pressure (atm) by various researchers. A well known speed of sound equation is an equation published in JASA by Del Grosso⁴, Chen & Millero⁵, Mackenzie², Coppens³. The evaluated equation is the complicated polynomial equation that UNESCO⁶ revised an equation of Chen & Millero for the moment. However, Meinen¹³ and Dushaw¹⁴ did suggestion to revise an expression of UNESCO based on the latest measured value.

2.2. An absorption loss calculation program in seawater

The sound to propagate seawater attenuates by spreading loss and absorption α (dB/km) of the seawater (fresh water, B(OH), MgSO₄). The α was the element which was the most basic to design the SONAR and an equation based on

various measurements data has been published by many researchers. Thorp⁷ is famous as a simple equation, and Schulkin & Marsh⁸, Fisher & Simmon⁹, Francois & Garrison^{10,11} and Ainslie & McColm¹² are known as a detailed expression. However, there are few measurement examples in the deep sea area.¹⁶

3. Creating of the program

3.1. Direct calculation program¹⁷

You can enter the calculation website at the top page of <http://www.tsuchiya2.org/>. Sound speed and the absorption / propagation loss by a selected equation in the various researchers are calculated in a direct calculation website. When a client inputs a parameter, a calculation result is displayed promptly by a browser. The parameter input screen in the sound speed calculation is shown in Fig.1.

Fig.1 The example of the sound speed direct calculation parameter input screen

The calculation result is shown in Fig.2. An input parameter and pressure and the sound speed by the equation of each researcher are displayed on the screen. These values are pasted on an editor by copying it from Web-browser.

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Temperature = 2(degrees Celsius)
Salinity = 35(parts per thousand)
Depth = 6000(meters)

Pressure = 613.066(kg/cm2)

Results of Sound Speed Equations

Mackenzie = 1561.453(meter/sec)
Coppens = 1562.615(meter/sec)
DelGrosso = 1561.695(meter/sec)
UNESCO = 1562.453(meter/sec)

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Fig.2 The result of the sound speed by the direct calculation

The direct calculation site of absorption loss alpha and propagation loss TL was constructed, too. In this site, frequency and PH in seawater are input other than the depth of the water, water temperature, salt as a parameter. The indication example of the calculation result is shown in Fig.3.

3.2. Depth direction profile calculation

Also the website that calculated the profile of the depth direction was produced. This profile is important data to improve the precision of an echo sounder and the acoustic navigation device. When a client inputs various parameters in this site and uploads a CSV file (depth, temperature, salinity), sound speed or the absorption profile by an equation chosen in radio button are calculated.

Frequency = 100(kHz)
 Temperature = 2(degrees Celsius)
 Salinity = 35(parts per thousand)
 Depth = 6000(meters)
 PH = 8
 Propagation Renge = 1(km)

Absorption Loss

Thorp = 34.1119(dB/km)
 Schulkin & Marsh = 22.60847(dB/km)
 Fisher & Simmons = 15.41027(dB/km)
 Francois & Garrison = 11.43372(dB/km)
 Ainslie & McColm = 11.01845(dB/km)

Transmission Loss (Spherical spreading) at 1(km)

Thorp = 94.1119(dB)
 Schulkin & Marsh = 82.60847(dB)
 Fisher & Simmons = 75.41027(dB)
 Francois & Garrison = 71.43372(dB)
 Ainslie & McColm = 71.01845(dB)

Fig.3 The screen of the absorption calculation result

A figure of flow of the absorption calculation is shown in Fig.4 as an example. The HTML part in this figure transmits an input parameter to a PHP part of the server via the Internet from a browser and displays a calculation result carried out for WEB browser again. As for this CSV file, the size of CSV file is not limited by a reason erased after a calculation immediately.

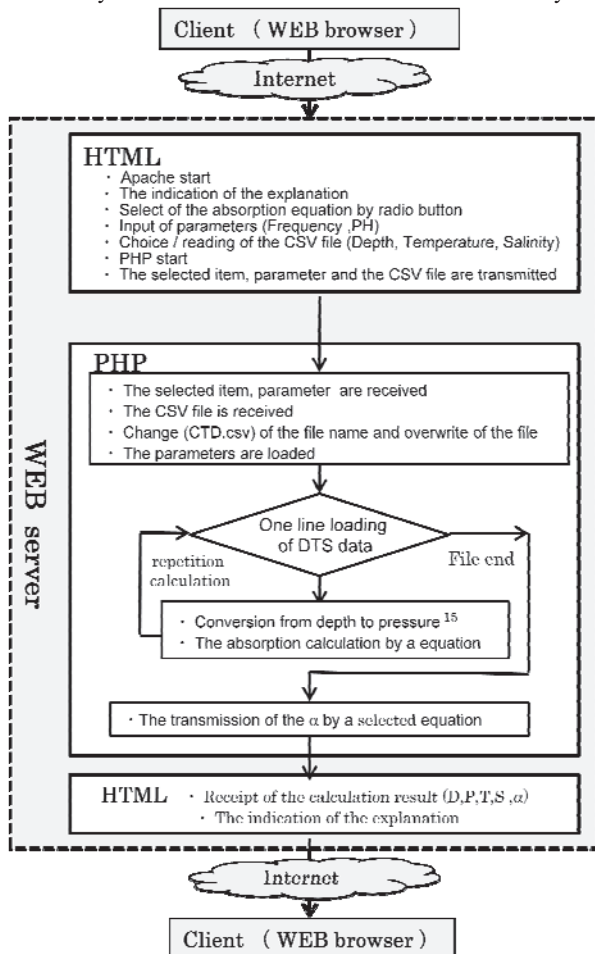


Fig.4 The flow of the absorption profile program

Fig.5 is a parameter input screen in Fig.4. A calculation result indication screen is shown in Fig6. The CSV file of the calculation result is used by graph tool software easily by copy and paste. In addition, the sound speed profile is calculated in the other pages on this Website.

Please input a necessary value into the following columns.

Frequency (kHz)

PH (Input "8" when there are not data.)

Please choose which equation you use ? (You must confirm a range)

Thorp

Schulkin & Marsh

Fisher & Simmons

Francois & Garrison

Ainslie & McColm

Please choose a your CSV (D,T,S) file:

C:\Users#tutiyat#Documents#CTD#-29_04_CTD.csv

Fig.5 The example of the parameter input screen

Equation of Francois & Garrison

Frequency = 100(kHz)
 PH = 8

-29_09_CTD.csv file was uploaded.

Depth(m),Temperature(degC),Salinity(ppt),Absorption Loss(dB/km)

3,18.552,35.618,38.65
 4,18.552,35.618,38.64414
 5,18.553,35.618,38.63878
 6,18.554,35.618,38.63373

 5066,1.155,34.734,12.54316
 5067,1.155,34.734,12.54157

Fig.6 The example of the result of the absorption profile

4. Conclusion

A calculation website of the ocean acoustics was produced on WEB server. An Internet user (client) does not depend on the OS and is easily hereby available through a browser. In addition, a SONAR engineer is available like an calculator by a cell-phone. The author wants to expand various calculation sites helping a ocean acoustics study.

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