

Package ‘sonar’

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AbsorptionAlphaAinslieMcColm
<i>Calculation of absorption in sea water from Ainslie and McColm 1998</i>

Description

Returns the absorption in sea water from Ainslie and McColm 1998

Usage

AbsorptionAlphaAinslieMcColm(f, temperatureC, S, D, pH)

Arguments

f	frequency (kHz)
temperatureC	temperature in degrees C
S	salinity in %
D	depth in meters
pH	pH

Value

the absorption

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Calculation of absorption of sound in seawater <http://resource.npl.co.uk/acoustics/techguides/seaabsorption/>

References

Ainslie and McColm 1998 J. Acoust. Soc. Am., Vol. 103, No. 3

Examples

```
AbsorptionAlphaAinslieMcColm(20, 0, 30, 0, 7)
```

AbsorptionAlphaFisherSimmons

Calculation of absorption in sea water from Fisher and Simmons 1977

Description

Returns the absorption in sea water from Fisher and Simmons 1977

Usage

```
AbsorptionAlphaFisherSimmons(f, temperatureC, D)
```

Arguments

f	frequency (kHz)
temperatureC	temperature in degrees C
D	depth in meters

Value

the absorption

Author(s)

Jose Gama

Source

Fisher and Simmons, 1977 J. Acoust. Soc. Am., Vol. 62, No. 3, September 1977

Examples

```
AbsorptionAlphaFisherSimmons(20, 0, 1)
```

AbsorptionSoundFreshWaterFrancoisGarrison

Calculation of absorption of sound in fresh water From Francois & Garrison 1982

Description

Returns the absorption of sound in fresh water From Francois & Garrison 1982 Total absorption = Pure Water Contrib.

Usage

AbsorptionSoundFreshWaterFrancoisGarrison(SonarFreq, temperatureC, D)

Arguments

SonarFreq	sonar frequency (kHz)
temperatureC	temperature (degC)
D	depth in meters

Value

the absorption of sound

Author(s)

Jose Gama

Source

Echoview, 2016 Sonar calculator algorithms http://support.echoview.com/WebHelp/Reference/Algorithms/Sonar_calculator_algorithms.htm

References

Francois & Garrison 1982 Sound absorption based on ocean measurements: Part I: Pure water and magnesium sulfate contributions J. Acoust. Soc. Am., Vol. 72, No. 6

Examples

AbsorptionSoundFreshWaterFrancoisGarrison(50, 0, 0)

AbsorptionSoundSeaWaterFrancoisGarrison

Calculation of absorption of sound in sea water From Francois & Garrison 1982

Description

Returns the absorption of sound in sea water From Francois & Garrison 1982 Total absorption = Boric Acid Contrib. + Magnesium Sulphate Contrib. + Pure Water Contrib.

Usage

AbsorptionSoundSeaWaterFrancoisGarrison(SonarFreq, temperatureC, Salinity, D, pH)

Arguments

SonarFreq	sonar frequency (kHz)
temperatureC	temperature (degC)
Salinity	Salinity (ppt)
D	depth in meters
pH	pH

Value

the absorption of sound

Author(s)

Jose Gama

Source

NPL, 2016 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water <http://resource.npl.co.uk/acoustics/techguides/seaabsorption/>

References

Francois & Garrison 1982 Sound absorption based on ocean measurements: Part I: Pure water and magnesium sulfate contributions J. Acoust. Soc. Am., Vol. 72, No. 6

Examples

AbsorptionSoundSeaWaterFrancoisGarrison(50, 0, 35, 0, 6)

BandLevelFlatSpectrum *band level (BL) for flat spectrum*

Description

Returns the total intensity of the sound in a band for flat spectrum

Usage

BandLevelFlatSpectrum(SpL, deltaf)

Arguments

SpL	spectrum level
deltaf	band frequency

Value

band level (BL)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 10.

Examples

```
BandLevelFlatSpectrum( 3, 2 )
```

BandLevelFromCompleteBand
band level (BL) from complete band

Description

Returns the band level from integrating the intensity over the complete band

Usage

BandLevelFromCompleteBand(I0, f1, f2)

Arguments

I0	spectrum level
f1	lower frequency
f2	upper frequency

Value

band level (BL)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 10.

Examples

```
BandLevelFromCompleteBand( 10000, 40000, 50000 )
```

BasicActiveSonarEquation
basic active sonar equation

Description

Returns the basic active sonar equation $SE = (SL + TS - 2 * PL) - N - DT$

Usage

```
BasicActiveSonarEquation(SL, TS, PL, N, DT)
```

Arguments

SL	is the source level of the target
TS	target strength
PL	propagation loss
N	noise
DT	detection threshold

Value

SE signal excess (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 120.

BasicPassiveSonarEquation
basic passive sonar equation

Description

Returns the basic passive sonar equation $SE = (SL - PL) - N = DT$

Usage

BasicPassiveSonarEquation(SL, PL, N)

Arguments

SL	is the source level of the target
PL	propagation loss
N	noise

Value

SE signal excess (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 120.

BasicSonarEquation	<i>basic sonar equation</i>
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Description

Returns the basic sonar equation $SE = S - N + DT$

Usage

BasicSonarEquation(S, N, DT)

Arguments

S	signal
N	noise
DT	detection threshold

Value

SE signal excess (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 120.

CavitationThresholdEstimateFunctionOfDepth
<i>Cavitation threshold estimate as a function of depth</i>

Description

Returns the Cavitation threshold estimate as a function of depth line passing by (5, 2) and (50, 50)

Usage

CavitationThresholdEstimateFunctionOfDepth(d)

Arguments

d	depth (meters)
---	----------------

Value

Cavitation threshold

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 6.

Examples

```
CavitationThresholdEstimateFunctionOfDepth( 1 )
```

CavitationThresholdEstimateFunctionOfRadiatedAcousticPowerIntensity

Cavitation threshold estimate as a function of radiated acoustic power intensity

Description

Returns the Cavitation threshold estimate as a function of radiated acoustic power intensity line passing by (2, 5) and (50, 50)

Usage

```
CavitationThresholdEstimateFunctionOfRadiatedAcousticPowerIntensity(Ir)
```

Arguments

Ir radiated acoustic power intensity

Value

Cavitation threshold

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 6.

Examples

```
CavitationThresholdEstimateFunctionOfRadiatedAcousticPowerIntensity ( 1000 )
```

CorrectiveTermsDepthFromPressure

Corrective terms to be added for obtaining depth from pressure

Description

Corrective terms to be added for obtaining depth (m) from pressure (MPa)

Usage

CorrectiveTermsDepthFromPressure

Format

dataframe with 13 rows and 5 columns:

No Number

Area.of.applicability Area of applicability

Expression.for.deltaf Expression for deltaf

Latitude Latitude in degrees

Accuracy Accuracy

Author(s)

Jose Gama

References

C. C. Leroy and F Parthiot, 1998 Depth-pressure relationship in the oceans and seas. J. Acoust. Soc. Am. 103(3) pp 1346-1352

CorrectiveTermsPressureFromDepth

Corrective terms to be subtracted for obtaining pressure from depth

Description

Corrective terms to be added for obtaining pressure (MPa) from depth (m)

Usage

CorrectiveTermsPressureFromDepth

Format

dataframe with 14 rows and 5 columns:

No Number

Area.of.applicability Area of applicability

Expression.for.deltaf Expression for deltaf

Latitude Latitude in degrees

Accuracy Accuracy

Author(s)

Jose Gama

References

C. C. Leroy and F Parthiot, 1998 Depth-pressure relationship in the oceans and seas. J. Acoust. Soc. Am. 103(3) pp 1346-1352

CutoffFrequencyShallowWater

Calculation of cutoff frequency in shallow water from Jensen et Al 2011

Description

Returns the cutoff frequency in shallow water from Jensen et Al 2011

Usage

CutoffFrequencyShallowWater(Cw, Cb, D)

Arguments

Cw	velocity of sound in water
Cb	velocity of sound in homogeneous bottom
D	depth in meters

Value

the cutoff frequency (Hz)

Author(s)

Jose Gama

Source

Finn B. Jensen, William A. Kuperman, Michael B. Porter, Henrik Schmidt, 2011 Computational Ocean Acoustics, 2nd Edition. Springer. pp. 29

Examples

```
CutoffFrequencyShallowWater(3000, 2500, 1)
```

CutoffFrequencyWater *Calculation of cutoff frequency in water from Jensen et Al 2011*

Description

Returns the cutoff frequency in water from Jensen et Al 2011

Usage

```
CutoffFrequencyWater(Cw, D)
```

Arguments

Cw	velocity of sound in water
D	depth in meters of isothermal surface layer

Value

the cutoff frequency (Hz)

Author(s)

Jose Gama

Source

Finn B. Jensen, William A. Kuperman, Michael B. Porter, Henrik Schmidt, 2011 Computational Ocean Acoustics, 2nd Edition. Springer. pp. 26

Examples

```
CutoffFrequencyWater(3000, 1)
```

`DepthToPressureLeroyParthiot`*Depth To Pressure from Leroy Parthiot 1998*

Description

Returns the Depth To Pressure from Leroy Parthiot 1998

Usage

`DepthToPressureLeroyParthiot(D, latitude, CorrectiveTerm = NA)`

Arguments

<code>D</code>	depth in meters
<code>latitude</code>	latitude in degrees
<code>CorrectiveTerm</code>	optional corrective term

Value

the Pressure

Author(s)

Jose Gama

Source

C. C. Leroy and F Parthiot, 1998 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water <http://resource.npl.co.uk/acoustics/techguides/soundseawater/>

References

C. C. Leroy and F Parthiot, 1998 Depth-pressure relationship in the oceans and seas (1998) J. Acoust. Soc. Am. 103(3) pp 1346-1352

Examples

`DepthToPressureLeroyParthiot(0, 0)`

DetectionIndex	<i>Detection index</i>
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Description

Returns the Detection index

Usage

```
DetectionIndex(S, N)
```

Arguments

S	signal
N	noise

Value

Detection index

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 120.

fuelStabilizer	<i>Number of milliliters or drops of stabilizer are needed to stabilize a certain amount of fuel</i>
----------------	--

Description

Returns the number of milliliters or drops of stabilizer are needed to stabilize a certain amount of fuel

Usage

```
fuelStabilizer(Lfuel, mLstabilizer = 25, Lstabilizer2fuel = 20,  
  dropml = 0.05)
```

Arguments

Lfuel	numeric, liters of fuel to stabilize
mLstabilizer	numeric, manufacturer's recommended milliliters of stabilizer per liters of fuel
Lstabilizer2fuel	numeric, manufacturer's recommended liters of fuel per mms of stabilizer
dropml	numeric, how many milliliters per drop

Value

the number of milliliters or drops of stabilizer

Author(s)

Jose Gama

Examples

```
# liqui moly, petrol stabilizer CNG/LPG gasoline stabilizer
# 25ml of stabilizer are the recommended amount for 20 litres of gasoline
# stabilizer for 1l of gasoline
fuelStabilizer(1)
# stabilizer for 0.5l of gasoline
fuelStabilizer(0.5)
```

HydrophoneSensitivity *Hydrophone Sensitivity*

Description

Returns the Hydrophone Sensitivity

Usage

HydrophoneSensitivity(p, v)

Arguments

p	sound pressure in micropascals at the hydrophone
v	voltage at the open circuit terminals

Value

Hydrophone Sensitivity (dB/V)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 9.

Examples

```
HydrophoneSensitivity( 1000, 2 )
```

InternationalFormulaForGravity
International Formula For Gravity

Description

Returns the average gravity at certain latitude

Usage

```
InternationalFormulaForGravity(latitude, CorrectiveTerm = NA)
```

Arguments

latitude latitude in degrees
CorrectiveTerm optional corrective term

Value

the average gravity

Author(s)

Jose Gama

Source

Fofonoff and R.C. Millard, 1983 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water <http://resource.npl.co.uk/acoustics/techguides/soundseawater/>

References

Saunders P.M., Fofonoff N.P., 1976 Conversion of pressure to depth in the ocean. Deep Sea Research 23:109-111.

Examples

```
InternationalFormulaForGravity(0)
```

MaximumRadiatedPowerToAvoidCavitation
Maximum radiated power to avoid cavitation

Description

Returns the Maximum radiated power to avoid cavitation

Usage

MaximumRadiatedPowerToAvoidCavitation(radiatingSurfaceArea, cavitationThreshold)

Arguments

radiatingSurfaceArea
Radiating surface area
cavitationThreshold
Cavitation threshold

Value

Maximum radiated power

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 5.

Examples

MaximumRadiatedPowerToAvoidCavitation(50, 0.7)

MolecularRelaxationAttenuationCoefficient
Molecular relaxation attenuation coefficient (alpha)

Description

Returns the attenuation coefficient of absorption losses due to molecular relaxation

Usage

MolecularRelaxationAttenuationCoefficient

Format

dataframe with 3 rows and 11 columns:

temperatureC numeric, temperature in degrees Celsius

0.5 attenuation coefficient for 0.5 kHz

1 attenuation coefficient for 1 kHz

2 attenuation coefficient for 2 kHz

5 attenuation coefficient for 5 kHz

10 attenuation coefficient for 10 kHz

20 attenuation coefficient for 20 kHz

50 attenuation coefficient for 50 kHz

100 attenuation coefficient for 100 kHz

200 attenuation coefficient for 200 kHz

500 attenuation coefficient for 500 kHz

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 47.

MolecularRelaxationAttenuationCoefficientApproximation

Molecular relaxation attenuation coefficient approximation

Description

Returns the Molecular relaxation attenuation coefficient approximation

Usage

MolecularRelaxationAttenuationCoefficientApproximation(f)

Arguments

f frequency (Hz)

Value

alpha Molecular relaxation attenuation coefficient

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 47.

Examples

```
MolecularRelaxationAttenuationCoefficientApproximation( 1000 )
```

PeakTS

peak pressure of the incident and reflected pulses

Description

Returns the peak pressure of the incident and reflected pulses

Usage

```
PeakTS(Pr, Pi)
```

Arguments

Pr	pressure of the reflected pulse
Pi	pressure of the incident pulse

Value

Target Strength (TS)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 68.

Examples

```
PeakTS( 900, 1000 )
```

PlaneWaveIntensity	<i>Plane wave intensity</i>
--------------------	-----------------------------

Description

Returns the intensity

Usage

PlaneWaveIntensity(p, rho, C)

Arguments

p	pressure (Pa or N/m ²)
rho	fluid density = 10 ³ kg/m ³ for sea water
C	velocity of sound wave propagation = 1.5 x 10 ³ m/s in sea water

Value

intensity of the wave (power / unit area) (Watt / m²)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 3.

Examples

PlaneWaveIntensity(1e3, 1.5e3, 1)

PlaneWavePressure	<i>Plane wave pressure</i>
-------------------	----------------------------

Description

Returns the pressure

Usage

PlaneWavePressure(rho, C, u)

Arguments

rho	fluid density = 10^3kg/m^3 for sea water
C	velocity of sound wave propagation = $1.5 \times 10^3 \text{m/s}$ in sea water
u	particle velocity (m/s)

Value

pressure (Pa or N/m²)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 2.

Examples

```
PlaneWavePressure( 1e3, 1.5e3, 1)
```

PLcylindricalSpreadingLaw

PL to range r cylindrical spreading law in logarithmic form

Description

Returns the PL to range r cylindrical spreading law in logarithmic form

Usage

```
PLcylindricalSpreadingLaw(r)
```

Arguments

r	radius (meters)
---	-----------------

Value

Propagation loss (PL) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 45.

Examples

```
PLcylindricalSpreadingLaw( 1000 )
```

```
PLSphericalSpreadingAndAbsorption
```

PL Spherical Spreading and Absorption

Description

Returns the PL Spherical Spreading and Absorption

Usage

```
PLSphericalSpreadingAndAbsorption(r, alpha)
```

Arguments

r	radius (meters)
alpha	Molecular relaxation attenuation coefficient

Value

Propagation loss (PL) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 48.

Examples

```
PLSphericalSpreadingAndAbsorption( 1000, 0.9 )
```

`PLsphericalSpreadingLaw`*PL to range r spherical spreading law in logarithmic form*

Description

Returns the PL to range r spherical spreading law in logarithmic form

Usage

`PLsphericalSpreadingLaw(r)`

Arguments

`r` radius (meters)

Value

Propagation loss (PL) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 44.

Examples

`PLsphericalSpreadingLaw( 1000 )`

`PowerCylindricalSpreadingLaw`*Power cylindrical spreading law*

Description

Returns the Power cylindrical spreading law

Usage

`PowerCylindricalSpreadingLaw(r, h, Ir)`

Arguments

r	radius (meters)
h	distance between 2 planes (meters)
Ir	intensity at radius r

Value

total power (Watts)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 45.

Examples

```
PowerCylindricalSpreadingLaw( 1000, 100, 500 )
```

PowerSphericalSpreadingLaw

Power spherical spreading law

Description

Returns the Power spherical spreading law

Usage

```
PowerSphericalSpreadingLaw(r, Ir)
```

Arguments

r	radius (meters)
Ir	intensity at radius r

Value

total power (Watts)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 44.

Examples

```
PowerSphericalSpreadingLaw( 1000, 500 )
```

PressureBalticSimplifiedLeroy

Calculation of pressure in the Baltic from Leroy 1969

Description

Returns the pressure in the Baltic from Leroy 1969

Usage

```
PressureBalticSimplifiedLeroy(Z, lat)
```

Arguments

Z	depth in meters
lat	latitude n degrees

Value

the pressure

Author(s)

Jose Gama

Source

Leroy C. C. 1969 Development of simple equations for accurate and more realistic calculations of the speed of sound in sea water J. Acoust. Soc. Am. 46, 216-226.

Examples

```
PressureBalticSimplifiedLeroy(0, 0)
```

PressureBlackSeaSimplifiedLeroy

Calculation of pressure in the Black Sea from Leroy 1969

Description

Returns the pressure in the Black Sea from Leroy 1969

Usage

PressureBlackSeaSimplifiedLeroy(Z, lat)

Arguments

Z	depth in meters
lat	latitude n degrees

Value

the pressure

Author(s)

Jose Gama

Source

Leroy C. C. 1969 Development of simple equations for accurate and more realistic calculations of the speed of sound in sea water J. Acoust. Soc. Am. 46, 216-226.

Examples

PressureBlackSeaSimplifiedLeroy(0, 0)

PressureModifiedSimplifiedLeroy

Calculation of pressure in water (Leroy modified) from Lovett 1978

Description

Returns the pressure in water (Leroy simplified modified) from Lovett 1978

Usage

PressureModifiedSimplifiedLeroy(Z, lat)

Arguments

Z	depth in meters
lat	latitude n degrees

Value

the pressure

Author(s)

Jose Gama

Source

Lovett, J.R. 1978 Merged seawater sound-speed equations J. Acoust. Soc. Am., 63, 1713-18.

Examples

```
PressureModifiedSimplifiedLeroy(0, 0)
```

PressureSimplifiedLeroy

Calculation of pressure in water simplified from Leroy 1969

Description

Returns the pressure in water simplified from Leroy 1969

Usage

```
PressureSimplifiedLeroy(Z, lat)
```

Arguments

Z	depth in meters
lat	latitude n degrees

Value

the pressure

Author(s)

Jose Gama

Source

Leroy C. C. 1969 Development of simple equations for accurate and more realistic calculations of the speed of sound in sea water J. Acoust. Soc. Am. 46, 216-226.

Examples

```
PressureSimplifiedLeroy(0, 0)
```

```
PressureToDepthLeroyParthiot
```

Pressure To Depth from Leroy Parthiot 1998

Description

Returns the Pressure To Depth from Leroy Parthiot 1998

Usage

```
PressureToDepthLeroyParthiot(P, latitude, CorrectiveTerm = NA)
```

Arguments

P	pressure in MPa (relative to atmospheric pressure)
latitude	latitude in degrees
CorrectiveTerm	optional corrective term

Value

the depth

Author(s)

Jose Gama

Source

C. C. Leroy and F Parthiot, 1998 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water <http://resource.npl.co.uk/acoustics/techguides/soundseawater/>

References

C. C. Leroy and F Parthiot, 1998 Depth-pressure relationship in the oceans and seas (1998) J. Acoust. Soc. Am. 103(3) pp 1346-1352

Examples

```
PressureToDepthLeroyParthiot(0.1, 0)
```

PressureToDepthSaundersFofonoff

Pressure To Depth from Saunders and Fofonoff 1976

Description

Returns the Pressure To Depth from Saunders and Fofonoff 1992 CHECKVALUE: DEPTH = 9712.653 M FOR P=10000 DECIBARS, LATITUDE=30 DEG ABOVE FOR STANDARD OCEAN: T=0 DEG. CELSIUS; S=35 (PSS-78)

Usage

PressureToDepthSaundersFofonoff(P, latitude)

Arguments

P	pressure in MPa (relative to atmospheric pressure)
latitude	latitude in degrees

Value

the depth

Author(s)

Jose Gama

Source

Unesco, 1983 Algorithms for computation of fundamental properties of seawater, 1983. Unesco Tech. Pap. in Mar. Sci., No. 44, 53 pp.

References

Saunders P.M., Fofonoff N.P., 1976 Conversion of pressure to depth in the ocean. Deep Sea Research 23:109-111

Examples

PressureToDepthSaundersFofonoff(0.1, 0)

ProjectorSensitivityPower
Projector Sensitivity Power

Description

Returns the Projector Sensitivity Power

Usage

ProjectorSensitivityPower(I1, Ir, P)

Arguments

I1	intensity of source at standard range
Ir	reference intensity
P	power (Watt)

Value

response Sv (dB/V)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 9.

Examples

ProjectorSensitivityPower(10000, 15000, 0.7)

ProjectorSensitivityVoltage
Projector Sensitivity Voltage

Description

Returns the Projector Sensitivity Voltage

Usage

ProjectorSensitivityVoltage(I1, Ir, v)

Arguments

I1	intensity of source at standard range
Ir	reference intensity
v	Voltage

Value

response Sv (dB/V)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 9.

Examples

```
ProjectorSensitivityVoltage( 10000, 15000, 0.7 )
```

PropagationLoss	<i>Propagation loss (PL)</i>
-----------------	------------------------------

Description

Returns the Propagation loss (PL)

Usage

```
PropagationLoss(I0, Ir)
```

Arguments

I0	intensity of the source to a point one metre from its acoustic centre
Ir	is the intensity at the receiver

Value

Propagation loss (PL) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 43.

Examples

PropagationLoss(1000, 500)

RangeResolutionCHIRP	<i>Sonar Range Resolution CHIRP</i>
----------------------	-------------------------------------

Description

Returns the Sonar Range Resolution CHIRP

Usage

RangeResolutionCHIRP(SonarBandwidth, Cw)

Arguments

SonarBandwidth	Sonar Bandwidth
Cw	Velocity of sound

Value

the Sonar Range Resolution

Author(s)

Jose Gama

Examples

RangeResolutionCHIRP(1, 343)

RangeResolutionMonotonic	<i>Sonar Range Resolution for monotonic acoustic systems</i>
--------------------------	--

Description

Returns the Sonar Range Resolution for monotonic acoustic systems

Usage

RangeResolutionMonotonic(SonarPulseDuration, Cw)

Arguments

SonarPulseDuration	Sonar Pulse Duration
Cw	Velocity of sound

Value

the Sonar Range Resolution

Author(s)

Jose Gama

Examples

```
RangeResolutionMonotonic(1, 343)
```

SLdirectionalProjector

SL of a directional projector

Description

Returns the SL of a directional projector

Usage

```
SLdirectionalProjector(P, DIIt)
```

Arguments

P	power output (watts)
DIIt	transmit directivity index (dB)

Value

SL of a directional projector

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 4.

Examples

```
SLdirectionalProjector( 700, 0.7 )
```

SLomnidirectionalProjector

SL of an omnidirectional projector

Description

Returns the SL of an omnidirectional projector

Usage

SLomnidirectionalProjector(P)

Arguments

P omnidirectional power output (watts)

Value

source level (SL)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 4.

Examples

SLomnidirectionalProjector(1000)

SonarEquation

sonar equation

Description

Returns the sonar equation $EL = SL - 2PL + TS$

Usage

SonarEquation(SL, PL, TS)

Arguments

SL	source level
PL	propagation loss
TS	target strength

Value

EL echo level

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 68.

SourceLevel	<i>source level (SL)</i>
-------------	--------------------------

Description

Returns the source level (SL)

Usage

SourceLevel(I1, Ir)

Arguments

I1	intensity of source at standard range
Ir	reference intensity

Value

source level (SL)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 4.

Examples

SourceLevel(1000, 1100)

SourceLevelToAvoidCavitation
<i>source level to avoid cavitation</i>

Description

Returns the source level to avoid cavitation

Usage

SourceLevelToAvoidCavitation(f, DIt)

Arguments

f	frequency (Hz)
DIt	transmit directivity index (dB)

Value

source level SL (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 5.

Examples

SourceLevelToAvoidCavitation(20000, 0.7)

SpeedAlgorithmParameterRanges
<i>Data on Speed of Sound Algorithm Parameter Ranges</i>

Description

Data on Speed of Sound Algorithm Parameter Ranges

Usage

SpeedAlgorithmParameterRanges

Format

dataframe with 10 rows and 10 columns:

- Reference** Reference
- TemperatureRangeMin** Temperature Range (C) Min
- TemperatureRangeMax** Temperature Range (C) Min
- SalinityRangeMin** Salinity Range (ppt) min
- SalinityRangeMax** Salinity Range (ppt) max
- PressureOrDepthRangeMin** Pressure or Depth Range min
- PressureOrDepthRangeMax** Pressure or Depth Range max
- PressureOrDepthRangeUnits** Pressure or Depth Range units
- StandardError** Standard Error
- NumberOfTerms** Number of Terms

Author(s)

Jose Gama

References

Paul C. Etter, 2013 Underwater Acoustic Modeling and Simulation, Fourth Edition pp. 28. CRC Press

SpeedOfSound	<i>Speed of sound</i>
--------------	-----------------------

Description

Returns the speed of sound from wavelength and frequency

Usage

SpeedOfSound(lambda, f)

Arguments

- lambda numeric, wavelength (meters)
- f numeric, frequency (Hz)

Value

the speed of sound (m/s)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 1.

Examples

```
SpeedOfSound( 5, 70)
```

SpeedOfSoundAir	<i>speed of sound in humid air at sea level air density and known atmospheric pressure</i>
-----------------	--

Description

Returns the speed of sound in humid air at sea level air density and known atmospheric pressure

Usage

```
SpeedOfSoundAir(temperatureC, Hr, pressurekPa)
```

Arguments

temperatureC	numeric, temperature in degrees Celsius in the range -30 C to 43 C
Hr	numeric, relative humidity, accurate to within 0.1% for temperatures
pressurekPa	numeric, atmospheric pressure in kPa

Value

the speed of sound (m/s)

Author(s)

Jose Gama

References

Kleeman L. & Kuc R., 2008 Springer Handbook of Robotics, Bruno Siciliano, Oussama Khatib (Eds.) Springer-Verlag Berlin Heidelberg, pp.496 eq (21.8).

Examples

```
#Speed of sound (Humid air, at sea level air density)
#temperature 20 C, 90% relative humidity, 101 kPa atmosphere pressure
SpeedOfSoundAir(20, 0.9, 101)
```

SpeedOfSoundDryAir	<i>Speed of sound in dry air at sea level air density and one atmosphere pressure</i>
--------------------	---

Description

Returns the speed of sound in dry air at sea level air density and one atmosphere pressure

Usage

SpeedOfSoundDryAir(temperatureC)

Arguments

temperatureC numeric, temperature in degrees Celsius accurate to within 1%

Value

the speed of sound (m/s)

Author(s)

Jose Gama

References

Kleeman L. & Kuc R., 2008 Springer Handbook of Robotics, Bruno Siciliano, Oussama Khatib (Eds.) Springer-Verlag Berlin Heidelberg, pp.496 eq (21.6).

Examples

```
#Speed of sound (dry air, at sea level air density, one atmosphere pressure)
#temperature 20 C
SpeedOfSoundDryAir(20)
```

SpeedOfSoundFreshWaterGrossoMader	<i>speed of sound (m/s) in fresh water from Grosso and Mader</i>
-----------------------------------	--

Description

Returns the speed of sound (m/s) Range of validity: 0-95C, D = 0, error +/-0.015

Usage

SpeedOfSoundFreshWaterGrossoMader(temperatureC)

Arguments

temperatureC temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Underwater Acoustics Technical Guides - Speed of Sound in Pure Water http://support.echoview.com/WebHelp/Reference/Algorithms/Sonar_calculator_algorithms.htm

References

Del Grosso, VA and Mader C.W., 1972 Speed of sound in pure water. J. acoust. Soc. Am., 52, 1442-6.

Examples

SpeedOfSoundFreshWaterGrossoMader(25)

SpeedOfSoundHumidAir *Speed of sound in Humid air at sea level air density and one atmosphere pressure*

Description

Returns the speed of sound in Humid air at sea level air density and one atmosphere pressure

Usage

SpeedOfSoundHumidAir(temperatureC, Hr)

Arguments

temperatureC numeric, temperature in degrees Celsius in the range -30 C to 43 C
Hr numeric, relative humidity, accurate to within 0.1% for temperatures

Value

the speed of sound (m/s)

Author(s)

Jose Gama

References

Kleeman L. & Kuc R., 2008 Springer Handbook of Robotics, Bruno Siciliano, Oussama Khatib (Eds.) Springer-Verlag Berlin Heidelberg, pp.496 eq (21.7).

Examples

```
#Speed of sound (Humid air, at sea level air density, one atmosphere pressure)
#temperature 20 C, 90% relative humidity
SpeedOfSoundHumidAir(20, 0.9)
```

SpeedOfSoundKinslerEtal

Speed of sound (m/s) from Kinsler et al

Description

Returns the speed of sound (m/s) from Kinsler et al accurate to within 0.05% for $0 \leq T \leq 100$ C and $0 \leq P \leq 200$ bar

Usage

SpeedOfSoundKinslerEtal(PressureBar, temperatureC)

Arguments

PressureBar	Pressure in bars (1 bar = 100 kPa)
temperatureC	temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

References

L. Kinsler, A. Frey, A. Coppens, J. Sanders, 1982 Fundamentals of Acoustics, Third Edition New York: John Wiley & Sons. pp. 121 (5.6.8)

Examples

```
SpeedOfSoundKinslerEtal(1, 20)
```

SpeedOfSoundPureWaterBelogolskiiSekoyanEtal

speed of sound (m/s) from Belogolskii, Sekoyan et al

Description

Returns the speed of sound (m/s) Range of validity: 0-40C, 0.1 - 60 MPa

Usage

SpeedOfSoundPureWaterBelogolskiiSekoyanEtal(temperatureC, pressureMegaPascals)

Arguments

temperatureC temperatureC in Celsius
pressureMegaPascals
 pressure in mega Pascals

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Underwater Acoustics Technical Guides - Speed of Sound in Pure Water <http://resource.npl.co.uk/acoustics/techguides/soundpurewater/content.html#LUBBERS>

References

Belogolskii, Sekoyan et al, 1999 Pressure dependence of the sound velocity in distilled water, Measurement Techniques, Vol 42, No 4, pp 406-413.

Examples

SpeedOfSoundPureWaterBelogolskiiSekoyanEtal(25, 1)

SpeedOfSoundPureWaterBilaniukWong112

speed of sound (m/s) from Bilaniuk and Wong 112 point equation

Description

Returns returns the speed of sound (m/s) Range of validity: 0-100 OC at atmospheric pressure

Usage

SpeedOfSoundPureWaterBilaniukWong112(temperatureC)

Arguments

temperatureC temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Underwater Acoustics Technical Guides - Speed of Sound in Pure Water <http://resource.npl.co.uk/acoustics/techguides/soundpurewater/content.html#LUBBERS>

References

Bilaniuk and Wong 1993 Speed of sound in pure water as a function of temperature, J. Acoust. Soc. Am. 93(3) pp 1609-1612 Bilaniuk and Wong 1996 Erratum: Speed of sound in pure water as a function of temperature [J. Acoust. Soc. Am. 93, 1609-1612 (1993)], J. Acoust. Soc. Am. 99(5), p 3257.

Examples

SpeedOfSoundPureWaterBilaniukWong112(20)

SpeedOfSoundPureWaterBilaniukWong148

speed of sound (m/s) from Bilaniuk and Wong 148 point equation

Description

Returns returns the speed of sound (m/s) Range of validity: 0-100 OC at atmospheric pressure

Usage

SpeedOfSoundPureWaterBilaniukWong148(temperatureC)

Arguments

temperatureC temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Underwater Acoustics Technical Guides - Speed of Sound in Pure Water <http://resource.npl.co.uk/acoustics/techguides/soundpurewater/content.html#LUBBERS>

References

Bilaniuk and Wong 1993 Speed of sound in pure water as a function of temperature, J. Acoust. Soc. Am. 93(3) pp 1609-1612 Bilaniuk and Wong 1996 Erratum: Speed of sound in pure water as a function of temperature [J. Acoust. Soc. Am. 93, 1609-1612 (1993)], J. Acoust. Soc. Am. 99(5), p 3257.

Examples

SpeedOfSoundPureWaterBilaniukWong148(20)

SpeedOfSoundPureWaterBilaniukWong36

speed of sound (m/s) from Bilaniuk and Wong 36 point equation

Description

Returns returns the speed of sound (m/s) Range of validity: 0-100 OC at atmospheric pressure

Usage

SpeedOfSoundPureWaterBilaniukWong36(temperatureC)

Arguments

temperatureC temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Underwater Acoustics Technical Guides - Speed of Sound in Pure Water <http://resource.npl.co.uk/acoustics/techguides/soundpurewater/content.html#LUBBERS>

References

Bilaniuk and Wong 1993 Speed of sound in pure water as a function of temperature, J. Acoust. Soc. Am. 93(3) pp 1609-1612 Bilaniuk and Wong 1996 Erratum: Speed of sound in pure water as a function of temperature [J. Acoust. Soc. Am. 93, 1609-1612 (1993)], J. Acoust. Soc. Am. 99(5), p 3257.

Examples

SpeedOfSoundPureWaterBilaniukWong36(20)

SpeedOfSoundPureWaterLubbersandGraaffSEa

*speed of sound (m/s) from Lubbers and Graaff's simplified equations
a and b*

Description

Returns returns the speed of sound (m/s) temperature interval 15-35 C at atmospheric pressure, maximum error 0.18 m/s Lubbers and Graaff's simplified equation a)

Usage

SpeedOfSoundPureWaterLubbersandGraaffSEa(temperatureC)

Arguments

temperatureC temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Underwater Acoustics Technical Guides - Speed of Sound in Pure Water <http://resource.npl.co.uk/acoustics/techguides/soundpurewater/content.html#LUBBERS>

References

J. Lubbers and R. Graaff, 1998 A simple and accurate formula for the sound velocity in water, Ultrasound Med. Biol. Vol 24, No 7, pp 1065-1068.

Examples

SpeedOfSoundPureWaterLubbersandGraaffSEa(20)

SpeedOfSoundPureWaterLubbersandGraaffSEb

*speed of sound (m/s) from Lubbers and Graaff's simplified equations
a and b*

Description

Returns returns the speed of sound (m/s) temperature interval 10-40C at atmospheric pressure, maximum error 0.18 m/s Lubbers and Graaff's simplified equation b)

Usage

SpeedOfSoundPureWaterLubbersandGraaffSEb(temperatureC)

Arguments

temperatureC temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Underwater Acoustics Technical Guides - Speed of Sound in Pure Water <http://resource.npl.co.uk/acoustics/techguides/soundpurewater/content.html#LUBBERS>

References

J. Lubbers and R. Graaff, 1998 A simple and accurate formula for the sound velocity in water, Ultrasound Med. Biol. Vol 24, No 7, pp 1065-1068.

Examples

SpeedOfSoundPureWaterLubbersandGraaffSEb(20)

SpeedOfSoundPureWaterMarczak

speed of sound (m/s) from Marczak

Description

Returns returns the speed of sound (m/s) Range of validity: 0-95C at atmospheric pressure

Usage

SpeedOfSoundPureWaterMarczak(temperatureC)

Arguments

temperatureC temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

National Physical Laboratory, 2015 Underwater Acoustics Technical Guides - Speed of Sound in Pure Water <http://resource.npl.co.uk/acoustics/techguides/soundpurewater/content.html#LUBBERS>

References

Marczak, 1997 Water as a standard in the measurements of speed of sound in liquids J. Acoust. Soc. Am. 102(5) pp 2776-2779.

Examples

SpeedOfSoundPureWaterMarczak(20)

SpeedOfSoundSeaWaterChenAndMillero

speed of sound (m/s) in sea water from Chen and Millero 1977

Description

Returns the speed of sound (m/s) Range of validity: temperature 0 to 40 C, salinity 0 to 40 parts per thousand, pressure 0 to 1000 bar

Usage

SpeedOfSoundSeaWaterChenAndMillero(S, temperatureC, P)

Arguments

S	salinity in parts per thousand
temperatureC	temperature in degrees Celsius
P	pressure in kg/cm ²

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

C-T. Chen and F.J. Millero, 1977 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water <http://resource.npl.co.uk/acoustics/techguides/soundseawater/>

References

C-T. Chen and F.J. Millero, 1977 Speed of sound in seawater at high pressures J. Acoust. Soc. Am. 62(5) pp 1129-1135

Examples

SpeedOfSoundSeaWaterChenAndMillero(30, 0, 1.019716)

SpeedOfSoundSeaWaterCoppens

speed of sound (m/s) in sea water from Coppens 1981

Description

Returns the speed of sound (m/s) Range of validity: temperature 0 to 35 C salinity 0 to 45 parts per thousand and depth 0 to 4000 m

Usage

SpeedOfSoundSeaWaterCoppens(D, S, temperatureC)

Arguments

D	depth in meters
S	salinity in parts per thousand
temperatureC	temperature in degrees Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

A.B. Coppens, 1981 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water <http://resource.npl.co.uk/acoustics/techguides/soundseawater/>

References

A.B. Coppens, 1981 Simple equations for the speed of sound in Neptunian waters J. Acoust. Soc. Am. 69(3), pp 862-863

Examples

SpeedOfSoundSeaWaterCoppens(0, 35, 25)

SpeedOfSoundSeaWaterDelGrosso

speed of sound (m/s) in sea water from Del Grosso 1974

Description

Returns the speed of sound (m/s) Range of validity: temperature 0 to 30 C, salinity 30 to 40 parts per thousand pressure 0 to 1000 kg/cm² , where 100 kPa=1.019716 kg/cm²

Usage

SpeedOfSoundSeaWaterDelGrosso(S, temperatureC, P)

Arguments

S	salinity in parts per thousand
temperatureC	temperature in degrees Celsius
P	pressure in kg/cm ²

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

V.A. Del Grosso, 1974 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water
<http://resource.npl.co.uk/acoustics/techguides/soundseawater/>

References

V.A. Del Grosso, 1974 New equation for the speed of sound in natural waters (with comparisons to other equations). J. Acoust. Soc. Am 56(4) pp 1084-1091.

Examples

SpeedOfSoundSeaWaterDelGrosso(30, 0, 1.019716)

SpeedOfSoundSeaWaterFryeAndPugh

Calculation of speed of sound in sea water from Frye and Pugh 1971

Description

Returns the speed of sound in sea water from Frye and Pugh 1971

Usage

SpeedOfSoundSeaWaterFryeAndPugh(temperatureC, S, P)

Arguments

temperatureC	temperature from -3C to 30C
S	salinity from 33.1 to -36.6 per 1000
P	hydrostatic pressure from 1.033 to 984.3 kg/cm ²

Value

the speed of sound

Author(s)

Jose Gama

Source

Frye, H.W. and Pugh, J.D. 1971 A new equation for the speed of sound in seawater J. Acoust. Soc. Am., 50, 384-6.

References

Frye, H.W. and Pugh, J.D. 1971 A new equation for the speed of sound in seawater J. Acoust. Soc. Am., 50, 384-6.

Examples

SpeedOfSoundSeaWaterFryeAndPugh(0, 30, 1.033)

SpeedOfSoundSeaWaterLeroy68

speed of sound (m/s) in sea water from Leroy 1968

Description

Returns the speed of sound (m/s)

Usage

SpeedOfSoundSeaWaterLeroy68(D, latitude)

Arguments

D	depth in meters
latitude	latitude in degrees

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

Lurton, X, 2002 An Introduction to Underwater Acoustics, 1st ed. London, Praxis Publishing LTD, p37.

References

Lurton, X, 2002 An Introduction to Underwater Acoustics, 1st ed. London, Praxis Publishing LTD, p37.

Examples

SpeedOfSoundSeaWaterLeroy68(25, 0)

SpeedOfSoundSeaWaterLeroy69

speed of sound (m/s) in sea water from Leroy 1969

Description

Returns the speed of sound (m/s) Range of validity: -2:23 C, Error +/-0.1

Usage

SpeedOfSoundSeaWaterLeroy69(D, S, temperatureC)

Arguments

D	depth in meters
S	salinity in parts per thousand
temperatureC	temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

Leroy C.C. 1969 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water http://support.echoview.com/WebHelp/Reference/Algorithms/Sonar_calculator_algorithms.htm

References

Leroy C.C. 1969 Development of simple equations for accurate and more realistic calculation of the speed of sound in sea water. J. acoust. Soc. Am., 46, 216-26.

Examples

SpeedOfSoundSeaWaterLeroy69(0, 35, 25)

SpeedOfSoundSeaWaterLeroyEtAl2008
<i>Calculation of speed of sound in sea water from Leroy et Al 2008</i>

Description

Returns the speed of sound in sea water from Leroy et Al 2008

Usage

SpeedOfSoundSeaWaterLeroyEtAl2008(temperatureC, S, D, L)

Arguments

temperatureC	temperature in degrees C 1990 universal temperature scale
S	salinity in ‰
D	depth in meters
L	latitude in degrees

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

Leroy, C.C., Robinson, S.P., and Goldsmith, M.J. 2008 A new equation for the accurate calculation of sound speed in all oceans J. Acoust. Soc. Am., 124, 2774-82.

Examples

SpeedOfSoundSeaWaterLeroyEtAl2008(0, 30, 0, 0)

`SpeedOfSoundSeaWaterLovett1`*Calculation of speed of sound in sea water from Lovett 1978*

Description

Returns the speed of sound in sea water from Lovett 1978 Check value: at T=2C, S=34.7; P=6000 dbar; C = 1559.462 m/s.

Usage

```
SpeedOfSoundSeaWaterLovett1(temperatureC, S, P)
```

Arguments

temperatureC	temperature in degrees C T48
S	salinity in ‰
P	pressure in decibars (0 at surface)

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

Lovett, J.R. 1978 Merged seawater sound-speed equations J. Acoust. Soc. Am., 63, 1713-18.

Examples

```
SpeedOfSoundSeaWaterLovett1(2, 34.7, 6000)
```

`SpeedOfSoundSeaWaterLovett2`*Calculation of speed of sound in sea water from Lovett 1978b*

Description

Returns the speed of sound in sea water from Lovett 1978b Check value: at T=2C, S=34.7; P=6000 dbar; C = 1559.393 m/s.

Usage

SpeedOfSoundSeaWaterLovett2(temperatureC, S, P)

Arguments

temperatureC	temperature in degrees C T48
S	salinity in %
P	pressure in decibars (0 at surface)

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

Lovett, J.R. 1978 Merged seawater sound-speed equations J. Acoust. Soc. Am., 63, 1713-18.

Examples

SpeedOfSoundSeaWaterLovett2(2, 34.7, 6000)

SpeedOfSoundSeaWaterLovett3

Calculation of speed of sound in sea water from Lovett 1978c

Description

Returns the speed of sound in sea water from Lovett 1978c Check value: at T=2C, S=34.7; P=6000 dbar; C = 1559.499 m/s.

Usage

SpeedOfSoundSeaWaterLovett3(temperatureC, S, P)

Arguments

temperatureC	temperature in degrees C T48
S	salinity in %
P	pressure in decibars (0 at surface)

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

Lovett, J.R. 1978 Merged seawater sound-speed equations J. Acoust. Soc. Am., 63, 1713-18.

Examples

```
SpeedOfSoundSeaWaterLovett3(2, 34.7, 6000)
```

SpeedOfSoundSeaWaterMackenzie

speed of sound (m/s) in sea water from Mackenzie 1981

Description

Returns the speed of sound (m/s)

Usage

```
SpeedOfSoundSeaWaterMackenzie(D, S, temperatureC)
```

Arguments

D	depth in meters
S	salinity in parts per thousand
temperatureC	temperatureC in Celsius

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

Mackenzie K.V., 1981 Underwater Acoustics Technical Guides - Speed of Sound in Sea Water
http://support.echoview.com/WebHelp/Reference/Algorithms/Sonar_calculator_algorithms.htm

References

Mackenzie K.V., 1981 Nine-term equation for sound speed in the ocean. J. acoust. Soc. Am., 70, 807-12.

Examples

```
SpeedOfSoundSeaWaterMackenzie(0, 35, 25)
```

```
SpeedOfSoundSeaWaterMedwin
```

speed of sound (m/s) in sea water from Medwin 1975

Description

Returns the speed of sound (m/s) (approximation) Range of validity: limited to 1000 meters in depth

Usage

```
SpeedOfSoundSeaWaterMedwin(temperatureC, D, S)
```

Arguments

temperatureC	temperature in degrees Celsius
D	depth in meters
S	salinity in parts per thousand

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

X Lurton, 2002 An Introduction to Underwater Acoustics, 1st ed. London, Praxis Publishing LTD

References

Medwin H, 1975 Speed of sound in water: A simple equation for realistic parameters Journal of the Acoustical Society of America, 58, 1318-1319, 1975

Examples

```
SpeedOfSoundSeaWaterMedwin(0, 1, 30)
```

SpeedOfSoundSeaWaterSkone

speed of sound (m/s) in sea water from Skone et al 2002

Description

Returns the speed of sound (m/s) modelled using empirical formulae

Usage

SpeedOfSoundSeaWaterSkone(temperatureC, D, S)

Arguments

temperatureC	temperature in degrees Celsius
D	depth in meters
S	salinity in parts per thousand

Value

the speed of sound (m/s)

Author(s)

Jose Gama

Source

de Jong, C.D., Lachapelle, G., Skone, S. and Elema, I. A., 2002 Hydrography. Delft University Press (The Netherlands). pp.194

References

de Jong, C.D., Lachapelle, G., Skone, S. and Elema, I. A., 2002 Hydrography. Delft University Press (The Netherlands). pp.194

Examples

SpeedOfSoundSeaWaterSkone(0, 1, 30)

SpeedOfSoundSeaWaterWilson

Calculation of speed of sound in sea water from Wilson 1960

Description

Returns the speed of sound in sea water from Wilson 1960

Usage

SpeedOfSoundSeaWaterWilson(temperatureC, S, P)

Arguments

temperatureC	temperature from -4C to 30C
S	salinity from 0 to 37 per 1000
P	hydrostatic pressure from 0.1 MPa to 100 MPa

Value

the speed of sound

Author(s)

Jose Gama

Source

N. N. Andreyev Acoustics Institute, 2015 The speed of sound in sea water http://www.akin.ru/spravka_eng/s_i_svel_e.htm

References

Wilson W D, 1960 Equation for the speed of sound in sea water J. Acoust. Soc. Amer., vol.32, N 10, p. 1357

Examples

SpeedOfSoundSeaWaterWilson(0, 30, 0.1)

TargetStrength	<i>Target Strength (TS)</i>
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Description

Returns the Target Strength (TS), the echo returned by an underwater target

Usage

TargetStrength(Ir, Ii)

Arguments

Ir	reflected intensity referred to 1 m from the acoustic centre of the target
Ii	incident intensity

Value

Target Strength (TS)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 67.

Examples

TargetStrength(900, 1000)

TargetStrengthCircularPlateNormal
<i>target strength Circular Plate normal</i>

Description

Returns the target strength Circular Plate normal

Usage

TargetStrengthCircularPlateNormal(r, lambda)

Arguments

r	radius (meters)
lambda	wavelength

Value

Target Strength (TS) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 70.

Examples

```
TargetStrengthCircularPlateNormal( 10, 500 )
```

TargetStrengthConvexSurface
target strength Convex surface

Description

Returns the target strength Convex surface

Usage

```
TargetStrengthConvexSurface(r1, r2)
```

Arguments

r1	principal radii (meters)
r2	principal radii (meters)

Value

Target Strength (TS) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 70.

Examples

```
TargetStrengthConvexSurface( 100, 50 )
```

TargetStrengthCylinderNormal
target strength Cylinder normal

Description

Returns the target strength Cylinder normal

Usage

```
TargetStrengthCylinderNormal(r, L, lambda)
```

Arguments

r	radius (meters)
L	length (meters)
lambda	wavelength

Value

Target Strength (TS) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 70.

Examples

```
TargetStrengthCylinderNormal( 10, 5, 500 )
```

TargetStrengthCylinderThetaToNormal
<i>target strength Cylinder, theta to normal</i>

Description

Returns the target strength Cylinder, theta to normal

Usage

TargetStrengthCylinderThetaToNormal(r, L, lambda, theta)

Arguments

r	radius (meters)
L	length (meters)
lambda	wavelength
theta	angle to normal

Value

Target Strength (TS) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 70.

Examples

TargetStrengthCylinderThetaToNormal(10, 5, 500, 45)

TargetStrengthPlateAnyShape
target strength Plate of any shape

Description

Returns the target strength Plate of any shape

Usage

TargetStrengthPlateAnyShape(A, lambda)

Arguments

A	area (meters)
lambda	wavelength

Value

Target Strength (TS) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 70.

Examples

TargetStrengthPlateAnyShape(10, 500)

TargetStrengthRectangularPlateNormal
target strength Rectangular Plate normal

Description

Returns the target strength Rectangular Plate normal

Usage

TargetStrengthRectangularPlateNormal(A, B, lambda)

Arguments

A	side, $A \geq B$ (meters)
B	side (meters)
lambda	wavelength

Value

Target Strength (TS) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 70.

Examples

```
TargetStrengthRectangularPlateNormal( 10, 500, 500 )
```

TargetStrengthRectangularPlateThetaToNormal

target strength Rectangular Plate, theta to normal

Description

Returns the target strength Rectangular Plate, theta to normal

Usage

```
TargetStrengthRectangularPlateThetaToNormal(A, B, lambda, theta)
```

Arguments

A	side, $A \geq B$ (meters)
B	side (meters)
lambda	wavelength
theta	angle to normal

Value

Target Strength (TS) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 70.

Examples

```
TargetStrengthRectangularPlateThetaToNormal( 10, 500, 500, 45 )
```

TargetStrengthSphere *target strength sphere*

Description

Returns the target strength sphere

Usage

```
TargetStrengthSphere(r)
```

Arguments

r	radius (meters)
---	-----------------

Value

Target Strength (TS) (dB)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 69.

Examples

```
PeakTS( 900, 1000 )
```

TransmitDirectivityIndex
transmit directivity index

Description

Returns the transmit directivity index (DIt)

Usage

TransmitDirectivityIndex(Idir, Iomni)

Arguments

Idir	intensity along the axis of the beam pattern
Iomni	intensity of the equivalent non-directional projector

Value

transmit directivity index (DIt)

Author(s)

Jose Gama

References

Waite A. D., 2002 Sonar for Practising Engineers, 3rd Edition Chichester: Wiley. pp. 4.

Examples

```
TransmitDirectivityIndex( 700, 1000 )
```

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