Package ‘radar’

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Type Package

Title Fundamental Formulas for Radar

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Description Fundamental formulas for Radar, for attenuation, range, velocity, effectiveness, power, scatter, doppler, geometry, radar equations, etc. Based on Nick Guy's Python package PyRadarMet

License GPL (>= 3)

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R topics documented:

`ApertureWeightingFunctionsAntenna`
Antenna Characteristics for Aperture Weighting Functions

Description

`ApertureWeightingFunctionsAntenna` has Antenna Characteristics for Aperture Weighting Functions

Usage

```
ApertureWeightingFunctionsAntenna
```

Author(s)

Jose Gama

Source

G. Richard Curry, 2011 SciTech Publishing Radar Essentials, A Concise Handbook for Radar Design and Performance Analysis

References

G. Richard Curry, 2011 SciTech Publishing Radar Essentials, A Concise Handbook for Radar Design and Performance Analysis

Examples

```
data(ApertureWeightingFunctionsAntenna)
str(ApertureWeightingFunctionsAntenna)
```

`AttenuationAbsCoeff` *Absorption coefficient of a spherical particle*

Description

`AttenuationAbsCoeff` Absorption coefficient of a spherical particle. From Doviak and Zrnic (1993), Eqn 3.14a or Battan (1973), Eqn 6.6

Usage

```
AttenuationAbsCoeff(D, lam, m)
```

Arguments

`D`	Particle diameter (m)
`lam`	Radar wavelength (m)
`m`	Complex refractive index (unitless)

Value

`Qa`	Absorption coefficient [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Doviak, R.J. and Zrnic, D.S., 1993 Doppler radar and weather observations, Academic Press

Louis J. Battan, 1973 Radar Observation of the Atmosphere University of Chicago Press

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Doviak, R.J. and Zrnić, D.S., 1993 Doppler radar and weather observations, Academic Press

Louis J. Battan, 1973 Radar Observation of the Atmosphere University of Chicago Press

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`AttenuationExtCoeff` *Extinction coefficient of a spherical particle*

Description

`AttenuationExtCoeff` Extinction coefficient of a spherical particle. From Doviak and Zrnic (1993), Eqn 3.14a or Battan (1973), Eqn 6.5

Usage

```
AttenuationExtCoeff(D, lam, m)
```

Arguments

`D`	Particle diameter (m)
`lam`	Radar wavelength (m)
`m`	Complex refractive index (unitless)

Value

`Qe`	Extinction coefficient [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Doviak, R.J. and Zrnic, D.S., 1993 Doppler radar and weather observations, Academic Press

Louis J. Battan, 1973 Radar Observation of the Atmosphere University of Chicago Press

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Doviak, R.J. and Zrnić, D.S., 1993 Doppler radar and weather observations, Academic Press

Louis J. Battan, 1973 Radar Observation of the Atmosphere University of Chicago Press

`AttenuationScatCoeff` *Scattering coefficient of a spherical particle*

Description

`AttenuationScatCoeff` Scattering coefficient of a spherical particle. From Doviak and Zrnic (1993), Eqn 3.14a or Battan (1973), Eqn 6.5

Usage

```
AttenuationScatCoeff(D, lam, m)
```

Arguments

`D`	Particle diameter (m)
`lam`	Radar wavelength (m)
`m`	Complex refractive index (unitless)

Value

`Qs`	Scattering coefficient [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Doviak, R.J. and Zrnic, D.S., 1993 Doppler radar and weather observations, Academic Press

Louis J. Battan, 1973 Radar Observation of the Atmosphere University of Chicago Press

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Doviak, R.J. and Zrnić, D.S., 1993 Doppler radar and weather observations, Academic Press

Louis J. Battan, 1973 Radar Observation of the Atmosphere University of Chicago Press

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`ConversiondBZ2Z` *Conversion from dBZ (log) units to linear Z units*

Description

`ConversiondBZ2Z` Converts from dBZ (log) units to linear Z units

Usage

```
ConversiondBZ2Z(dBZ)
```

Arguments

`dBZ`	logarithmic reflectivity value

Value

`Z`	linear reflectivity units

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

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`ConversionZ2dBZ` *Conversion from linear Z units to dBZ (log) units*

Description

`ConversionZ2dBZ` Converts from linear Z units to dBZ (log) units

Usage

```
ConversionZ2dBZ(Zlin)
```

Arguments

`Zlin`	linear reflectivity units

Value

dBZ	logarithmic reflectivity value

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

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DopplerDilemma *Doppler dilemma*

Description

DopplerDilemma returns the Doppler dilemma From Rinehart (1997), Eqn 6.12

Usage

```
DopplerDilemma(inFloat, lam, speedOfLight)
```

Arguments

inFloat	Nyquist Velocity [m/s] or Maximum unambiguous range [m]
lam	Radar wavelength [m]
speedOfLight	speed of light

Value

Rmax	Maximum unambiguous range [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

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DopplerFmax *Maximum frequency given PRF*

Description

`DopplerFmax` returns the PRF for a maximum frequency From Rinehart (1997), Eqn 6.8

Usage

```
DopplerFmax(PRF)
```

Arguments

`PRF`	Pulse repetition frequency [Hz]

Value

`f`	Maximum frequency [Hz]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

DopplerFreq *Frequency given wavelength*

Description

DopplerFreq Converts from wavelength to frequency

Usage

```
DopplerFreq(lam, speedOfLight)
```

Arguments

lam	Wavelength [m]
speedOfLight	speed of light

Value

f	Frequency [Hz]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

DopplerPulseDuration *Pulse duration from pulse length*

Description

DopplerPulseDuration Converts from pulse length to pulse duration

Usage

```
DopplerPulseDuration(tau, speedOfLight)
```

Arguments

`tau`	Pulse length [m]
`speedOfLight`	speed of light

Value

`pDur`	Pulse duration [s]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

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`DopplerPulseLength` *Pulse length from pulse duration*

Description

`DopplerPulseLength` Converts from pulse duration to pulse length

Usage

```
DopplerPulseLength(pDur, speedOfLight)
```

Arguments

`pDur`	Pulse duration [s]
`speedOfLight`	speed of light

Value

`tau`	Pulse length [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

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`DopplerRmax` *Maximum unamiguous range*

Description

`DopplerRmax` returns the maximum unamiguous range From Rinehart (1997), Eqn 6.11

Usage

```
DopplerRmax(PRF, speedOfLight)
```

Arguments

`PRF`	Pulse repetition frequency [Hz]
`speedOfLight`	speed of light

Value

`Rmax`	Maximum unambiguous range [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

DopplerVmax *Nyquist velocity, or maximum unambiguous Doppler velocity (+ or -)*

Description

DopplerVmax returns the Nyquist velocity, or maximum unambiguous Doppler velocity (+ or -). From Rinehart (1997), Eqn 6.8

Usage

```
DopplerVmax(PRF, lam)
```

Arguments

PRF	Pulse repetition frequency [Hz]
lam	Radar wavelength [m]

Value

Vmax	Nyquist velocity [m/s], +/-

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

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`DopplerVmaxDual` *Doppler velocity from dual PRF scheme radar (+ or -)*

Description

`DopplerVmaxDual` returns Doppler velocity [m/s] from a mobile platform. From Jorgensen (1983), Eqn 2

Usage

```
DopplerVmaxDual(lam, PRF1, PRF2)
```

Arguments

`lam`	Radar wavelength [m]
`PRF1`	First Pulse repetition frequency [Hz]
`PRF2`	Second Pulse repetition frequency [Hz]

Value

`Vmax`	Doppler velocity [m/s]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Jorgensen, D., Hildebrand, P.H., and Frush, C., 1983 Feasibility test of an airborne pulse-Doppler meteorological Radar J. Clim. Appl. Meteorol

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Jorgensen, D., Hildebrand, P.H., and Frush, C., 1983 Feasibility test of an airborne pulse-Doppler meteorological Radar J. Clim. Appl. Meteorol

DopplerVshift *Adjusted Doppler velocity from a mobile platform*

Description

DopplerVshift returns Adjusted Doppler velocity from a mobile platform. From Jorgensen (1983), Eqn 2

Usage

```
DopplerVshift(GS, psi)
```

Arguments

GS	Gound speed [m/s]
psi	Angle between actual azimuth and fore/aft angle [deg]

Value

Vshift	Shift in Doppler velocity from mobile aspect [m/s]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Jorgensen, D., Hildebrand, P.H., and Frush, C., 1983 Feasibility test of an airborne pulse-Doppler meteorological Radar J. Clim. Appl. Meteorol

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Jorgensen, D., Hildebrand, P.H., and Frush, C., 1983 Feasibility test of an airborne pulse-Doppler meteorological Radar J. Clim. Appl. Meteorol

DopplerWavelength *Wavelength given frequency*

Description

DopplerWavelength Converts from frequency to wavelength

Usage

```
DopplerWavelength(freq, speedOfLight)
```

Arguments

freq	Frequency [Hz]
speedOfLight	speed of light

Value

lam	Wavelength [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

ElectronicWarfareFrequencyBands *Electronic Warfare Frequency Bands*

Description

ElectronicWarfareFrequencyBands has Electronic Warfare Frequency Bands

Usage

```
ElectronicWarfareFrequencyBands
```

Author(s)

Jose Gama

Source

G. Richard Curry, 2011 SciTech Publishing Radar Essentials, A Concise Handbook for Radar Design and Performance Analysis

References

G. Richard Curry, 2011 SciTech Publishing Radar Essentials, A Concise Handbook for Radar Design and Performance Analysis

Examples

```
data(ElectronicWarfareFrequencyBands)
str(ElectronicWarfareFrequencyBands)
```

GeometryBeamBlockFrac *Partial beam blockage fraction*

Description

GeometryBeamBlockFrac returns the partial beam blockage fraction From Bech et al. (2003), Eqn 2 and Appendix

Usage

```
GeometryBeamBlockFrac(Th, Bh, a)
```

Arguments

Th	Terrain height [m]
Bh	Beam height [m]
a	Half power beam radius [m]

Value

PBB	Partial beam blockage fraction [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Bech et al, 2003 The Sensitivity of Single Polarization Weather Radar Beam Blockage Correction to Variability in the Vertical Refractivity Gradient American Meteorological Society, AMS journals Volume 20 Issue 6

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Bech et al, 2003 The Sensitivity of Single Polarization Weather Radar Beam Blockage Correction to Variability in the Vertical Refractivity Gradient American Meteorological Society, AMS journals Volume 20 Issue 6

`GeometryHalfPowerRadius` *Half-power radius*

Description

`GeometryHalfPowerRadius` returns the half-power radius Battan (1973)

Usage

```
GeometryHalfPowerRadius(r, bwhalf)
```

Arguments

`r`	Range [m]
`bwhalf`	Half-power beam width [degrees]

Value

`Rhalf`	Half-power radius [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Louis J. Battan, 1973 Radar Observation of the Atmosphere University of Chicago Press

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Louis J. Battan, 1973 Radar Observation of the Atmosphere University of Chicago Press

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GeometryRangeCorrect *Half-power radius*

Description

`GeometryRangeCorrect` returns the half-power radius From CSU Radar Meteorology AT 741 Notes

Usage

```
GeometryRangeCorrect(r, h, E)
```

Arguments

`r`	Distance to sample volume from radar [m]
`h`	Height of the center of radar volume [m]
`E`	Elevation angle [deg]

Value

`rnew`	Adjusted range to sample volume [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

CSU Radar Meteorology AT 741 Notes

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

CSU Radar Meteorology AT 741 Notes

`GeometryRayHeight` *Center of radar beam height calculation*

Description

`GeometryRayHeight` returns the center of radar beam height From Rinehart (1997), Eqn 3.12, Bech et al. (2003) Eqn 3

Usage

```
GeometryRayHeight(r, elev, H0, R1=kConstantR43)
```

Arguments

`r`	Range from radar to point of interest [m]
`elev`	Elevation angle of radar beam [deg]
`H0`	Height of radar antenna [m]
`R1`	Effective radius [m]

Value

`h`	Radar beam height [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

`GeometryReffective` *Effective radius calculation*

Description

`GeometryReffective` returns the effective radius From Rinehart (1997), Eqn 3.9, solved for R'

Usage

```
GeometryReffective(dNdH=-39e-6, earthRadius)
```

Arguments

`dNdH`	Refraction [N x10^-6/km]
`earthRadius`	earth radius [m]

Value

`R`	Effective radius [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

`GeometrySampleVolGauss` *Sample volume assuming transmitted energy in Gaussian beam shape*

Description

`GeometrySampleVolGauss` returns the sample volume assuming transmitted energy in Gaussian beam shape. From Rinehart (1997), Eqn 5.4

Usage

```
GeometrySampleVolGauss(r, bwH, bwV, pLength)
```

Arguments

`r`	Range from radar to point of interest [m]
`bwH`	Horizontal beamwidth [deg]
`bwV`	Vertical beamwidth deg]
`pLength`	Pulse length [m]

Value

`sVol`	Sample Volume [m^3]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

GeometrySampleVolIdeal *Sample volume (idealized) assuming all power in half-power beamwidths*

Description

GeometrySampleVolIdeal returns the sample volume (idealized) From Rinehart (1997), Eqn 5.2

Usage

```
GeometrySampleVolIdeal(r, bwH, bwV, pLength)
```

Arguments

r	Range from radar to point of interest [m]
bwH	Horizontal beamwidth [deg]
bwV	Vertical beamwidth deg]
pLength	Pulse length [m]

Value

sVol	Sample Volume [m^3]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

kConstantSpeedOfLight *Constant speed of light*

Description

kConstantSpeedOfLight is "c" the constant speed of light [m/s].

kConstantSLP Sea-level Pressure [hPa].

kConstantP0 Reference pressure [hPa].

kConstantRe Earth's radius [m].

kConstantR43 4/3 Approximation effective radius for standard atmosphere [m].

kConstantBoltz Boltzmann's constant [m^2 kg s^-2 K^-1].

Usage

```
kConstantSpeedOfLight
```

Author(s)

Jose Gama

Examples

```
print(kConstantSpeedOfLight)
```

SystemAntEffArea *Antenna effective area*

Description

SystemAntEffArea returns the antenna effective area From Rinehart (1997), Eqn 4.5

Usage

```
SystemAntEffArea(G, lam)
```

Arguments

G	Antenna Gain [dB]
lam	Radar wavelength [m]

Value

Ae	Antenna effective area [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

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SystemFreq *Frequency given wavelength*

Description

`SystemFreq` Converts from wavelength to frequency

Usage

```
SystemFreq(lam, speedOfLight)
```

Arguments

`lam`	Wavelength [m]
`speedOfLight`	speed of light

Value

`f`	Frequency [Hz]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

SystemGainPratio *Antenna gain via power ratio*

Description

`SystemGainPratio` returns the antenna gain via power ratio From Rinehart (1997), Eqn 2.1

Usage

```
SystemGainPratio(P1, P2)
```

Arguments

`P1`	Power on the beam axis [W]
`P2`	Power from an isotropic antenna [W]

Value

`G`	Gain [dB]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

SystemNormXsecBscatterSphere

Normalized Backscatter cross-sectional area of a sphere using the Rayleigh approximation

Description

`SystemNormXsecBscatterSphere` returns the normalized Backscatter cross-sectional area of a sphere using the Rayleigh approximation From Rinehart (1997), Eqn 4.9 and 5.7 and Battan Ch. 4.5

Usage

```
SystemNormXsecBscatterSphere(D, lam, K=0.93)
```

Arguments

`D`	Diameter of target [m]
`lam`	Radar wavelength [m]
`K`	Dielectric factor [unitless]

Value

`sigNorm`	Normalized backscatter cross-section [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

L. J. Battan, 1973 Radar observation of the atmosphere The University of Chicago Press

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

L. J. Battan, 1973 Radar observation of the atmosphere The University of Chicago Press

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`SystemPowerReturnTarget` *Power returned by target located at the center of the antenna beam pattern*

Description

`SystemPowerReturnTarget` returns Power returned by target located at the center of the antenna beam pattern From Rinehart (1997), Eqn 4.7

Usage

```
SystemPowerReturnTarget(Pt, G, lam, sig, r)
```

Arguments

`Pt`	Transmitted power [W]
`G`	Antenna gain [dB]
`lam`	Radar wavelength [m]
`sig`	Backscattering cross-sectional area of target [m^2]
`r`	Distance to sample volume from radar [m]

Value

`Pr`	Power returned by target [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

SystemPowerTarget *Power intercepted by target*

Description

SystemPowerTarget returns the power intercepted by target From Rinehart (1997), Eqn 4.3

Usage

```
SystemPowerTarget(Pt, G, Asig, r)
```

Arguments

Pt	Transmitted power [W]
G	Antenna gain [dB]
Asig	Area of target [m^2]
r	Distance to sample volume from radar [m]

Value

Psig	Power intecepted by target [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

`SystemRadarConst` *Radar constant*

Description

`SystemRadarConst` returns radar constant From CSU Radar Meteorology notes, AT 741

Usage

```
SystemRadarConst(Pt, G, Tau, lam, bwH, bwV, Lm, Lr)
```

Arguments

`Pt`	Transmitted power [W]
`G`	Antenna gain [dB]
`Tau`	Pulse Width [s]
`lam`	Radar wavelength [m]
`bwH`	Horizontalntenna beamwidth [degrees]
`bwV`	Vertical antenna beamwidth [degrees]
`Lm`	Antenna/waveguide/coupler loss [dB]
`Lr`	Receiver loss [dB]

Value

`C`	Radar constant [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

CSU Radar Meteorology notes, AT 741

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

CSU Radar Meteorology notes, AT 741

`SystemSizeParam` *Size parameter calculation*

Description

`SystemSizeParam` returns the size parameter calculation From Rinehart (1997), Eqn 4.9 and 5.7 and Battan Ch. 4.5

Usage

```
SystemSizeParam(D, lam)
```

Arguments

`D`	Diameter of target [m]
`lam`	Radar wavelength [m]

Value

`alpha`	Size parameter [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

L. J. Battan, 1973 Radar observation of the atmosphere The University of Chicago Press

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

L. J. Battan, 1973 Radar observation of the atmosphere The University of Chicago Press

SystemThermalNoise *Thermal noise power*

Description

SystemThermalNoise returns the thermal noise power From CSU Radar Meteorology notes, AT741

Usage

```
SystemThermalNoise(Bn, Units, Ts=290, k=kConstantBoltz)
```

Arguments

Bn	Receiver bandwidth [Hz]
Units	String of nits desired, can be 'W' or 'dBm'
Ts	Reciever noise temperature [K]
k	Boltzmann's constant

Value

nt	Thermal noise power [W or 'dBm']

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

CSU Radar Meteorology notes, AT741

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

CSU Radar Meteorology notes, AT741

Systemwavelength *Wavelength given frequency*

Description

`Systemwavelength` Converts from frequency to wavelength

Usage

```
Systemwavelength(freq, speedOfLight)
```

Arguments

`freq`	Frequency [Hz]
`speedOfLight`	speed of light

Value

`lam`	Wavelength [m]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

SystemXsecBscatterSphere *Backscatter cross-sectional area of a sphere using the Rayleigh approximation*

Description

`SystemXsecBscatterSphere` returns Backscatter cross-sectional area of a sphere using the Rayleigh approximation From Rinehart (1997), Eqn 4.9 and 5.7

Usage

```
SystemXsecBscatterSphere(D, lam, K=0.93)
```

Arguments

D	Diameter of target [m]
lam	Radar wavelength [m]
K	Dielectric factor [unitless]

Value

sig	Backscattering cross-section [m*2]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

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VariablesCDR *Circular depolarization ratio*

Description

`VariablesCDR` returns the circular depolarization ratio From Rinehart (1997), Eqn 10.2

Usage

```
VariablesCDR(Zpar, Zorth)
```

Arguments

Zpar	Reflectivity in the parallel channel [mm^6/m^3]
Zorth	Reflectivity in the orthogonal channel [mm^6/m^3]

Value

CDR	Circular depolarization ratio [dB]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

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R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

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`VariablesHDR` *Differential reflectivity hail signature*

Description

`VariablesHDR` returns the differential reflectivity hail signature From Aydin et al. (1986), Eqns 4-5

Usage

```
VariablesHDR(dBZh, ZDR)
```

Arguments

dBZh	Horizontal reflectivity [dBZ]
ZDR	Differential reflectivity [dBZ]

Value

ZDP	Reflectivity difference [dB]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

Aydin et al., 1986

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

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`VariablesLDR` *Linear depolarization ratio*

Description

`VariablesLDR` returns the linear depolarization ratio From Rinehart (1997), Eqn 10.3

Usage

```
VariablesLDR(Zh, Zv)
```

Arguments

`Zh`	Horizontal reflectivity [mm^6/m^3]
`Zv`	Vertical reflectivity [mm^6/m^3]

Value

`LDR`	linear depolarization ratio

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

`VariablesRadVel` *Radial velocity*

Description

`VariablesRadVel` returns the radial velocity From Rinehart (1993), Eqn 6.6

Usage

```
VariablesRadVel(f,lam)
```

Arguments

`f`	Frequency shift [Hz]
`lam`	Radar wavelength [m]

Value

`Vr`	Radial velocity [m/s]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

`VariablesReflectivity` *Radar reflectivity*

Description

`VariablesReflectivity` returns the radar reflectivity From Rinehart (1993), Eqn 5.17 (See Eqn 5.14-5.16 also)

Usage

```
VariablesReflectivity(Pt, G, Tau, lam, bwH, bwV, Lm, Lr, Pr, r, K=0.93)
```

Arguments

`Pt`	Transmitted power [W]
`G`	Antenna gain [dB]
`Tau`	Pulse Width [s]
`lam`	Radar wavelength [m]
`bwH`	Horizontalntenna beamwidth [degrees]
`bwV`	Vertical antenna beamwidth [degrees]
`Lm`	Antenna/waveguide/coupler loss [dB]
`Lr`	Receiver loss [dB]
`Pr`	Returned power [W]
`r`	Range to target [m]
`K`	Dielectric factor [unitless]

Value

`Ze`	Radar reflectivity [unitless]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

References

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

VariablesZDP *Reflectivity difference*

Description

VariablesZDP returns the reflectivity difference From Rinehart (1997), Eqn 10.2

Usage

```
VariablesZDP(Zh, Zv)
```

Arguments

Zh	Horizontal reflectivity [mm^6/m^3]
Zv	Vertical reflectivity [mm^6/m^3]

Value

ZDP	Reflectivity difference [dB]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

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Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

VariablesZDR *Differential reflectivity*

Description

VariablesZDR returns the differential reflectivity From Rinehart (1997), Eqn 10.3 and Seliga and Bringi (1976)

Usage

```
VariablesZDR(Zh, Zv)
```

Arguments

Zh	Horizontal reflectivity [mm^6/m^3]
Zv	Vertical reflectivity [mm^6/m^3]

Value

ZDR	Differential reflectivity [dB]

Author(s)

Jose Gama

Source

Nick Guy, 2014 PyRadarMet - Python Fundamental Calculations in Radar Meteorology https://github.com/nguy/PyRadarMet

R. E. Rinehart, 1997 Radar for Meteorologists Rinehart Publishing

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