

Manual for Package: physics

Revision 11M

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1 @Physics

1.1 Physics

Physics and physical standard quantities

1.2 air_pressure

1.3 beam_bending_deflection

1.4 beam_bending_moment

1.5 beam_bending_strain

1.6 beam_bending_stress

1.7 bolt_stress

1.8 celsius_to_kelvin

convert temperature from degree Celsius to Kelvin
function t_K = celsius_to_kelvin(t_C)

1.9 depth_to_pressure

convert depth to pressure in fresh water at standard temperature

$$z = (p - p_0) / (\rho \cdot g)$$
$$\Rightarrow p = \rho \cdot g \cdot z + p_0$$

input :

p0 : nx1 or scalar, pressure at water surface in BAR
d : depth in metre

output :

p : nx1, pressure at measurement depth in BAR

1.10 drag_force

1.11 evapotranspiration_blaney

1.12 heat_convection_through_orifice

1.13 heat_transfer

1.14 kelvin_to_celsius

convert temperature degree Kelvin to Celsius

1.15 magnetic_pull_force

1.16 minimum_cable_diameter

1.17 moment_of_area

1.18 moment_of_inertia_rectangle

1.19 moment_of_inertia_ring

1.20 optical_attenuation

1.21 parabolic_reflector_gain

1.22 pressure_to_depth

convert pressure to depth in fresh water at standard temperature

$$z = (p - p_0)/(\rho \cdot g)$$

input:

p : nx1, pressure at measurement depth in BAR

p0 : nx1 or scalar, pressure at water surface in BAR

output:

d : depth in metre

1.23 saturation_vapor_pressure

1.24 sound_absorption_air

1.25 sound_absorption_water

sound absorption in water

following Francois and Garrison, 1982

function alpha = sound_absorption(f,S,D,T)

input:

f : frequency (Hz)

S : salinity

D : depth (m)

T : temperature (degree C)

output:

alpha = sound attenuation in dB/m (not dB/km)

function alpha = sound_absorption(f,S,D,T,model)

1.26 sound_velocity_water

sound velocity in water
following Lubbers and Graaff (1998)
this formula does not include depth and salinity effects

1.27 thermal_flux

1.28 viscosity_dynamic_water

1.29 viscosity_kinematic_water

2 acoustics/@Backscatter

2.1 Backscatter

acoustic backscatter processing

2.2 backscatter2ssc

convert backscatter to suspended sediment concentration
c.f lee hanes / sassi, with linear relation for reference
concentration

2.3 backscatter2ssc_implicit

convert backscatter to suspended sediment concentration

this is the method called "implicit" by hanes, though it is here
still

implemented in an explicit way, as "explicit/implicit" in hanes only
mean euler forward or trapezoidal integration

2.4 backscatter2ssc_implicit_sample

convert backscatter to suspended sediment concentration, implicit
method

2.5 backscatter2ssc_sample

convert backscatter 2 suspended sediment concentration

2.6 backscatter2ssc_sassi

convert backscatter to suspended sediment concentration
c.f. sassi

2.7 backscatter2ssc_sassi_sample

convert backscatter to suspended sediment concentration
c.f. sassi

2.8 fit

fit backscatter coefficients

```
function [res, leverage, w, obj] = fit(obj,ssc0,R0,R,bs,last,param0  
    )
```

ssc0	- ns x 1, reference concentration
R0	- ns x 1, distance to sample along beam
bs	- ns x nbin, backscatter profile per sample
R	- ns x nbin, distance to bin from transducer along beam
last	- last : index last valid bin
param0	- initial value for parameters

2.9 regmat

regression matrix

3 acoustics/backscatter

3.1 attenuation

acoustic attenuation coefficient of suspended particles

c.f hanes 2012

input

[d_mm] = mm : (sieve) diameter of particles
[f_hz] = Hz = 1/s : transducer frequency
[C_kgm3] = kg/m³ = mg/l : mass concentration of sediment

output

[a_s] = 1/m (neper) : total attenuation per unit distance
a_snu : viscous attenuation
a_ss : attenuation due to scattering
for db : chi_db = 8.7 chi_neper

for normalization : chi_s = a_s(C_kgm3=2650)

function [as,asnu,ass,X,chi] = attenuation_coefficient(d_mm,f,
C_kgm3,mode)

3.2 backscatter_coefficient

analytic determination of the backscatter coefficient

3.3 backscatter_coefficient_2

analytic backscatter coefficient
thorne 2002
thorne 2012

3.4 backscatter_form_function

acoustic backscatter form function

input

d_mm : particle diameter
f_Hz : transducer sound frequency

output
fbs :

3.5 backscatter_to_concentration

convert acoustic backscatter to suspended sediment mass
concentration
backscatter S has to be corrected for attenuation

3.6 backscatter_to_concentration2

convert acoustic backscatter to sediment concentration

3.7 calibrate_backscatter

3.8 derive_attenuation_coefficient

3.9 differential_cross_section_geometric

differential cross section
geometrical backscattering for spherical bodies
 $ka \gg 1$, large particles or high frequencies
k : wave number
a : radius of the particle

sigma

3.10 intensity_ratio_sphere

3.11 normalized_particle_radius

normalized particle radius

3.12 scattering_cross_section

3.13 scattering_cross_section3

3.14 scattering_cross_section_general

acoustic cross section ? of sediment particles
Medwin, ch. 7.5.3
Axially Symmetric Spherical Mode Solutions

3.15 scatterring_cross_section_merckelbach

3.16 sigma_rayleigh

Rayleigh scattering for a sphere ($ka \ll 1$)
small particles or low frequencies
Medwin 7.5.2 Rayleigh Scatter From a Sphere ($ka \ll 1$)

3.17 simulate_backscatter

backscatter as it would be measured,
when radial spreading, near field distortion and attenuation by
water have been corrected for,
i.e. backscatter as caused and attenuated by sediment

output :
bs : backscatter

```

    ibs : integral of backscatter from transducer

bs(R) = 1/ks(R)^2*C(R)*exp(-int_0^R 2 as(r) dr)
ibs(R) = int_0^R bs(r) dr

values are integrated by the midpoint rule

input :
dr_m : steps of radial distance from transducer,
      not necessarily along the vertical
d_mm : sediment diameter
C_kg : mass concentration of sediment given at mid-points
f_Hz : sound frequency of transducer

dimensions:
    1 (row)   : along range
    2 (column): ensemble / profile (space-time)
    3         : grain size class

```

3.18 ssc2backscatter

convert suspended sediment concentration to backscatter,
not including attenuation by sediment

```

function bs = ssc2backscatter(ssc,d_mm,f,varargin)

input
d_mm : particle radius
f_Hz : transducer frequency
C_kgm3 : mass concentration of sediment [ssc] = g/l = kg/m^3

output
bs : backscatter, [bs] = (m/s)^2

```

3.19 viscous_attenuation

4 acoustics

4.1 backscatter_form_function_theoretic

4.2 coherent_backscatter_threshold

4.3 sound_pressure_sphere_collision

4.4 sound_pressure_to_db

4.5 sound_reflection_water_surface

4.6 sound_transmission_coefficient

5 physics

5.1 distance_two_horizon

5.2 electrical_resistance

6 hydrogen-spectrum

6.1 hydrogen_spectrum_1d

6.2 hydrogen_spectrum_2012_12_02

6.3 hydrogen_spectrum_2d

6.4 hydrogen_spectrum_3d

7 hydrology

7.1 Weather

7.2 critical_pressure_head

7.3 derive_equilibrium_soil_moisture_profile_brooks_corey

7.4 dielectricity_to_soil_moisture

7.5 equilibrium_soil_moisture_profile_brooks_corey

7.6 hydraulic_conductivity_from_water_content

7.7 hydraulic_conductivity_genuchten_from_pressure

7.8 ice_bearing_thickness

7.9 ice_growth_thickness

7.10 infiltration_phillips

7.11 normalized_water_content

7.12 open_water_evaporation

7.13 potential_evapotranspiration_abtew

7.14 potential_evapotranspiration_blaney_criddle

7.15 potential_evapotranspiration_langbein

7.16 potential_evapotranspiration_makking

7.17 potential_evapotranspiration_turc

7.18 simulate_weather

7.19 soil_freezing_depth

7.20 solar_radiation

8 mechanics

8.1 moment_of_inertia_cylinder

8.2 shoreA_to_youngs_modulus

8.3 shoreD_to_youngs_modulus

8.4 strain

9 salinity

9.1 Salinity

9.2 Salinity78

9.3 canter_cremer_number

Canter Cremer Number
ratio of fresh water to sea water that flows into the estuary
Qf : fresh water discharge
T : tidal period
Pt : tidal prism
Savenije, Salinity and tides, eq. 1.1, 2.35 and 5.67

9.4 density2salinity

9.5 dispersion_hws_savenije

Dispersion at river mouth during high water slack

v0 : tidal velocity scale
E0 : tidal excursion
h0 : depth
a : convergence length
Nr : Richargson Number

Savenije 1993c, Savenije, Salinity and Tides, eg. 5.70

9.6 dispersion_tda_burgh

9.7 estuarine_richardson_number

9.8 richardson_number

Estuarine Richardson Number
potential energy due to mixing the entire fresh water with sea
water
ratio of potential energy and buoyancy
Savenije, Salinity and Tides, 2.36
drho : difference of sea water and fresh water density

rho : fresh water density
h : depth
v : tidal velocity scale
N : Cramer number

9.9 salinity_dot

9.10 salinity_from_dispersion_savenije

9.11 salinity_intrusion_length

9.12 salinity_ode

9.13 sea_water_density

9.14 tidal_discharge

specific tidal discharge (discharge per unit width)

9.15 tidal_excursion

Tidal excursion length
Pt : tidal prism
h0 : depth
w0 : width

9.16 tidal_prism_channel

Tidal prism
 $P_t = \int_{lsw}^{hws} Q_t dt \sim A E$
z1 : tidal amplitude
w0 : width of estuary at mouth
b : length of width convergence
dH_dx = rate of damping of H
c.f. Savenije 2.34, 2.64

9.17 tidal_prism_estuary

Tidal prism
 $P_t = \int_{lsw}^{hws} Q_t dt \sim A E$
z1 : tidal amplitude
w0 : width of estuary at mouth
b : length of width convergence
dH_dx = rate of damping of H
c.f. Savenije 2.34, 2.64

9.18 tidal_velocity

10 physics

10.1 test_sound_absorption_air

11 turbulence

11.1 keps2nu

12 wind-wave

12.1 short_wave_length

12.2 short_wave_shear_velocity

12.3 wave_height_from_wind_speed