Manual for Package: physics
Revision 11M

Karl Kästner

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1.1 Physics

`Physics and physical standard quantities`

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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 - p0)/(rho g)
=> p = rho g z + p0

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 - p0)/(rho*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 absrobption 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 methog called "implicit" by hanes, though it is here
    still
implemented in an explicit way, as "explicit/imlicit" 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

```
accoustic 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/m^3 = mg/l : mass concentration of sediment

output
[a_s]   = 1/m (neper) : total attenuation per unit distance
 a_snu  : viscuous 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 basckatter 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 >> 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 sectin ? 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 << 1)
small particles or low frequencies
Medwin 7.5.2 Rayleigh Scatter From a Sphere (ka << 1)
```

3.17 simulate_backscatter

```
backscatter as it would be measured,
when radial spreading, near field distortion and attnuation 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 attenuatio 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 viscuous_attenuation

4 acoustics

4.1 backscatter_form_function_theoretic

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4.4 sound_pressure_to_db

4.5 sound_reflection_water_surface

4.6 sound_transmission_coefficient

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6.1 hydrogen_spectrum_1d

6.2 hydrogen_spectrum_2012_12_02

6.3 hydrogen_spectrum_2d

6.4 hydrogen_spectrum_3d

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7.4 dielectricity_to_soil_moisture

7.5 equilibrium_soil_moisture_profile_brooks_corey

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7.7 hydraulic_conductivity_genuchten_from_pressure

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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
Pt = int_lsw^hws Q_t dt ~ 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
Pt = int_lsw^hws Q_t dt ~ 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

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