Clean_DiscontinuEnergie-RK3

October 15, 2022

1 Test de la nouvelle classe TimeProblem

[1]:
```
import sys
import os

lib_path = os.path.realpath(os.path.join(os.getcwd(), ".."))
if lib_path not in sys.path:
    sys.path = [lib_path] + sys.path
savefig_path = os.path.join(lib_path, "figures/")
save_fig = False
```

[2]:
```
from src.main_discontinu import *
from src.plot_fields import *
from src.time_problem import *
from src.plot_stats import *

%matplotlib inline
rc("figure", figsize=(10, 5))
rc("figure", dpi=100)
rc("font", size=18)
rc("legend", fontsize=16)
rc("text.latex", preamble=r"\usepackage{siunitx}")
```

1.1 Test des 3 opérateurs à maillage constant

Ici on va réaliser une simulation sans diffusion pour différentes écritures de notre équation thermique.

La résolution se fait à chaque fois en WENO avec Euler explicite en temps.

[3]:
```
n_lim = 10**8
t_fin_lim = 0.002
```

[4]:
```
# d = 6./100*Delta/2.
dx = 3.9 * 10**-5
phy_prop_conv = PhysicalProperties(
    Delta=0.02,
```

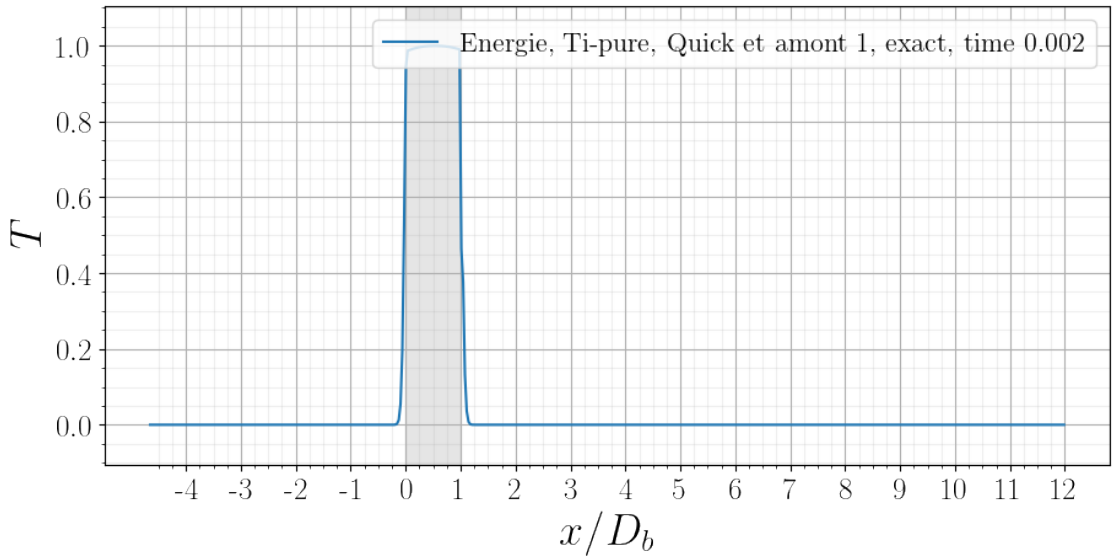
```
    v=0.2,
    dS=0.005**2,
    lda1=5.5 * 10**-2,
    lda2=15.5,
    rho_cp1=70278.0,
    rho_cp2=702780.0,
    diff=1.0,
    alpha=0.06,
    a_i=357.0,
)
phy_prop_no_conv = PhysicalProperties(
    Delta=0.02,
    v=0.0,
    dS=0.005**2,
    lda1=5.5 * 10**-2,
    lda2=15.5,
    rho_cp1=70278.0,
    rho_cp2=702780.0,
    diff=1.0,
    alpha=0.2,
    a_i=357.0,
)
num_prop_weno = NumericalProperties(
    dx=dx, schema="weno", time_scheme="rk3", phy_prop=phy_prop_conv, cfl=0.5
)
num_prop_quick = NumericalProperties(
    dx=dx, schema="quick", time_scheme="rk3", phy_prop=phy_prop_conv, cfl=0.5
)
num_prop_upwind = NumericalProperties(
    dx=dx, schema="upwind", time_scheme="rk3", phy_prop=phy_prop_conv, cfl=0.5
)
# markers = Bulles(phy_prop=phy_prop_conv, x=num_prop.x, n_bulle=1)
markers = Bulles(phy_prop=phy_prop_conv, n_bulle=1)
```

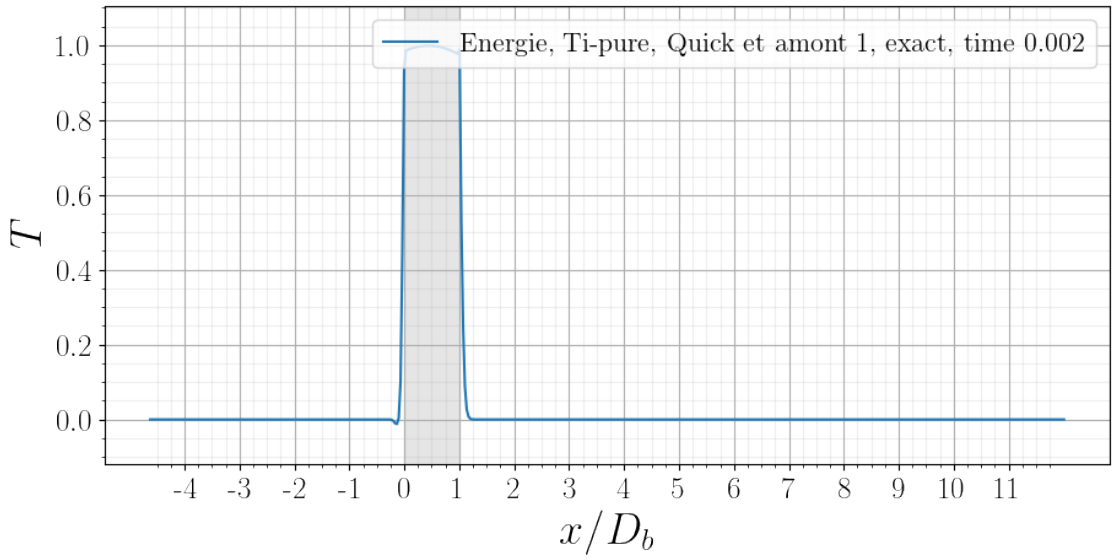
[5]:
```
t_fin = 10.0

prob_clean_weno_ref = TimeProblem(
    get_T_creneau,
    markers=markers,
    phy_prop=phy_prop_no_conv,
    num_prop=num_prop_weno,
    problem_state=StateProblemDiscontinuE,
)
t, e = prob_clean_weno_ref.timestep(
    t_fin=min(t_fin, t_fin_lim),
    n=n_lim,
    number_of_plots=1,
```

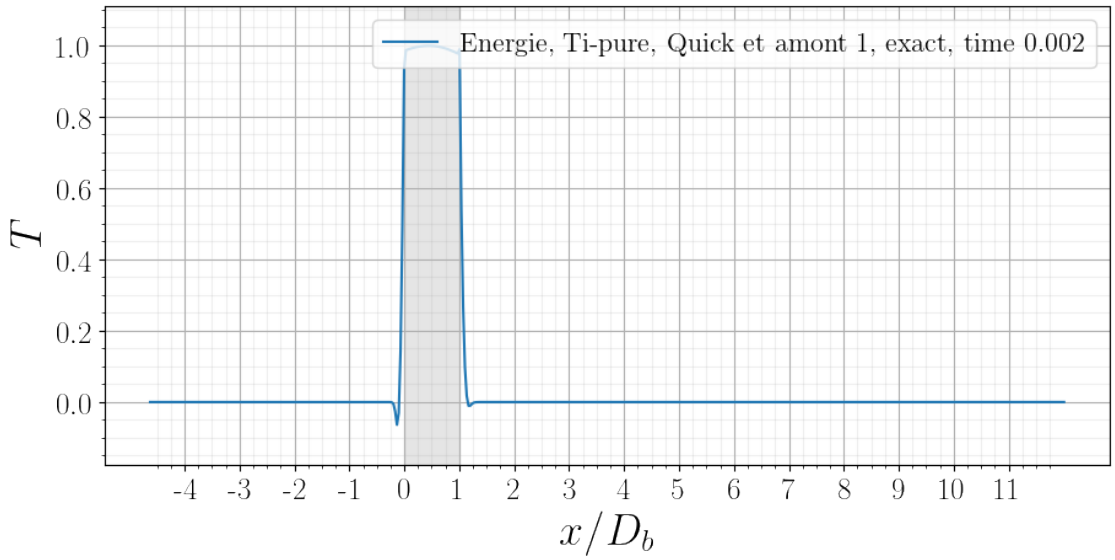
```
    plotter=Plotter("decale", ispretty=True),
)
prob_clean_weno = TimeProblem(
    get_T_creneau,
    markers=markers,
    phy_prop=phy_prop_conv,
    num_prop=num_prop_weno,
    problem_state=StateProblemDiscontinuE,
)
t, e = prob_clean_weno.timestep(
    t_fin=min(t_fin, t_fin_lim),
    n=n_lim,
    number_of_plots=1,
    plotter=Plotter("decale", ispretty=True),
)

prob_clean_quick = TimeProblem(
    get_T_creneau,
    markers=markers,
    phy_prop=phy_prop_conv,
    num_prop=num_prop_quick,
    problem_state=StateProblemDiscontinuE,
)
t, e = prob_clean_quick.timestep(
    t_fin=min(t_fin, t_fin_lim),
    n=n_lim,
    number_of_plots=1,
    plotter=Plotter("decale", ispretty=True),
)

prob_clean_upwind = TimeProblem(
    get_T_creneau,
    markers=markers,
    phy_prop=phy_prop_conv,
    num_prop=num_prop_upwind,
    problem_state=StateProblemDiscontinuE,
)
t, e = prob_clean_upwind.timestep(
    t_fin=min(t_fin, t_fin_lim),
    n=n_lim,
    number_of_plots=1,
    plotter=Plotter("decale", ispretty=True),
)
```

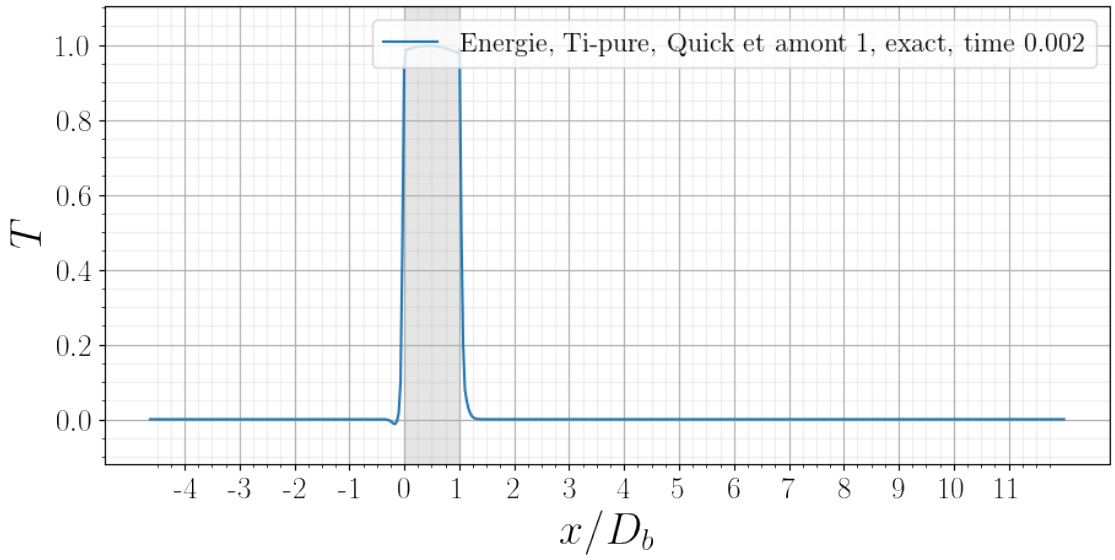
```
Monofluid convection :  weno

Energie
```

```
=======
dt fourier
6.918433404737903e-06
Db / dx = 30
Interface interp type :  Ti
Face interp :  quick
Time integration method for surfaces : exact
Monofluid convection :  weno

Energie
=======
dt fourier
6.918433404737903e-06
Db / dx = 30
Interface interp type :  Ti
Face interp :  quick
Time integration method for surfaces : exact
Monofluid convection :  quick

Energie
=======
dt fourier
6.918433404737903e-06
Db / dx = 30
Interface interp type :  Ti
Face interp :  quick
Time integration method for surfaces : exact
Monofluid convection :  upwind

Energie
=======
dt fourier
6.918433404737903e-06
Db / dx = 30
Interface interp type :  Ti
Face interp :  quick
Time integration method for surfaces : exact
```


Energie, Ti-pure, Quick et amont 1, exact, time 0.002
T
1.0
0.8
0.6
0.4
0.2
0.0
-4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11 12
x/D_b

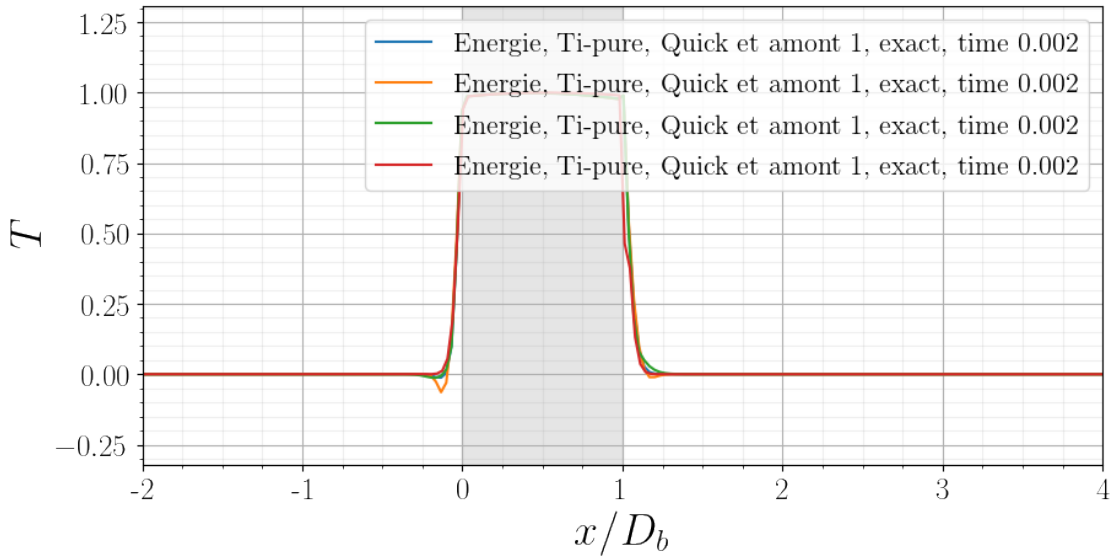

Energie, Ti-pure, Quick et amont 1, exact, time 0.002
T
1.0
0.8
0.6
0.4
0.2
0.0
-4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10 11
x/D_b





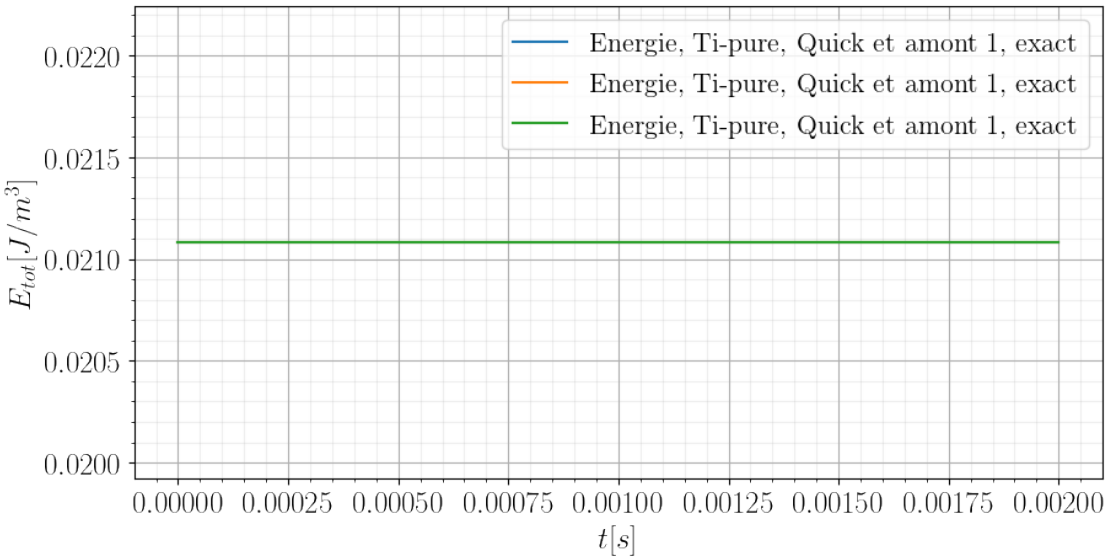
[6]:
```
plot = Plotter("decale", ispretty=True, zoom=(-2, 4))
plot.plot(prob_clean_weno.problem_state)
plot.plot(prob_clean_quick.problem_state)
plot.plot(prob_clean_upwind.problem_state)
plot.plot(prob_clean_weno_ref.problem_state)
```

[6]: '#d62728'



[7]:
```
plot_en = EnergiePlot()
plot_en.plot_tpb(prob_clean_weno)
plot_en.plot_tpb(prob_clean_quick)
plot_en.plot_tpb(prob_clean_upwind)
```

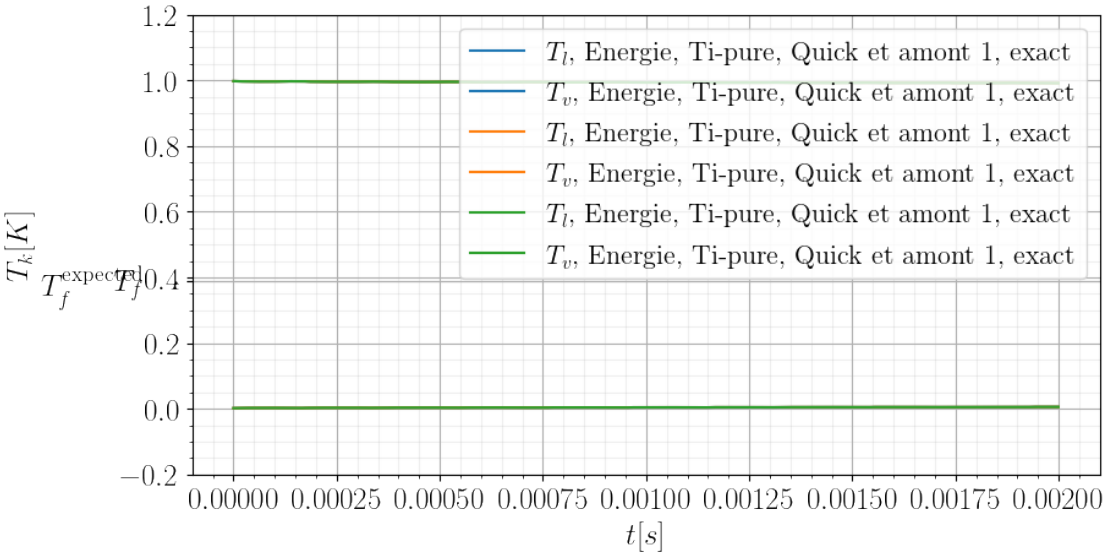
```
Energie, Ti-pure, Quick et amont 1, exact
==========================================
dE*/dt* = 2.13712e-18

Energie, Ti-pure, Quick et amont 1, exact
==========================================
dE*/dt* = 7.12373e-19

Energie, Ti-pure, Quick et amont 1, exact
==========================================
dE*/dt* = 1.42475e-18
```



[8]:
```
plot_T = TemperaturePlot()
plot_T.plot_tpb(prob_clean_weno)
plot_T.plot_tpb(prob_clean_quick)
plot_T.plot_tpb(prob_clean_upwind)
plot_T.add_T_final()
```

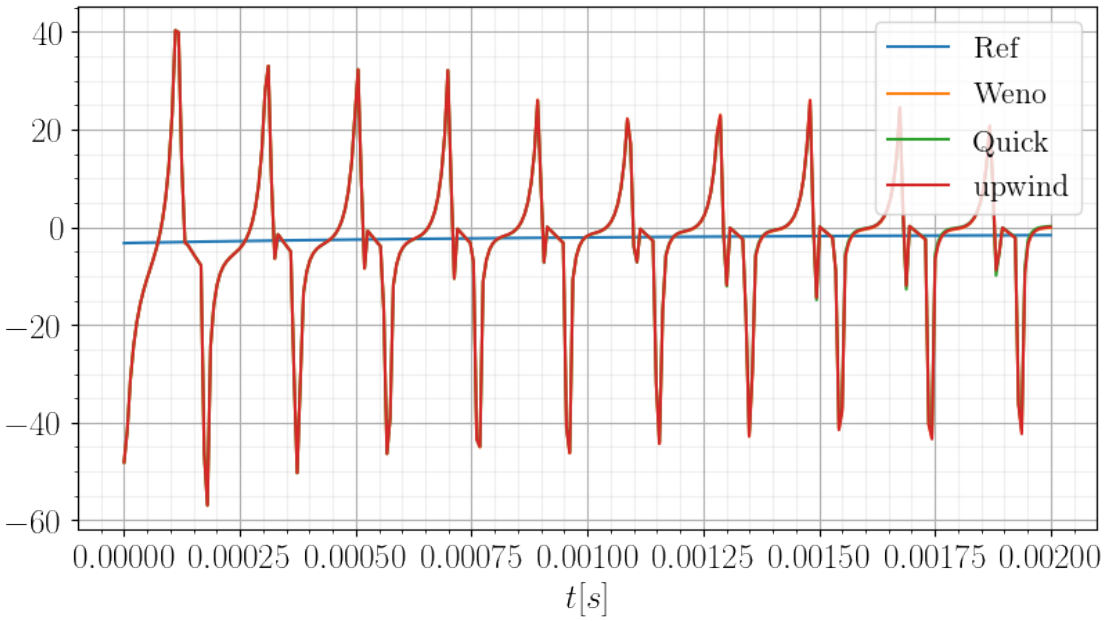
```
$T_l$, Energie, Ti-pure, Quick et amont 1, exact
================================================
dT/dt = 1.44463

$T_v$, Energie, Ti-pure, Quick et amont 1, exact
================================================
dT/dt = -2.26325

$T_l$, Energie, Ti-pure, Quick et amont 1, exact
================================================
dT/dt = 1.41422

$T_v$, Energie, Ti-pure, Quick et amont 1, exact
================================================
dT/dt = -2.21561

$T_l$, Energie, Ti-pure, Quick et amont 1, exact
================================================
dT/dt = 1.42852

$T_v$, Energie, Ti-pure, Quick et amont 1, exact
================================================
```

```
dT/dt = -2.23801
```



[9]:
```
def plot_dTdt(stat, plot, **args):
    dTdt = np.gradient(stat.Tv, stat.t)
    plot.ax.plot(stat.t, dTdt, **args)
```

[10]:
```
plot_dT = TimePlot()
plot_dTdt(prob_clean_weno_ref.stat, plot_dT, label="Ref")
plot_dTdt(prob_clean_weno.stat, plot_dT, label="Weno")
plot_dTdt(prob_clean_quick.stat, plot_dT, label="Quick")
plot_dTdt(prob_clean_upwind.stat, plot_dT, label="upwind")
le = plot_dT.ax.legend()
```


40
20
0
−20
−40
−60
0.00000
0.00025
0.00050
0.00075
0.00100
0.00125
0.00150
0.00175
0.00200
$t[s]$
Ref
Weno
Quick
upwind