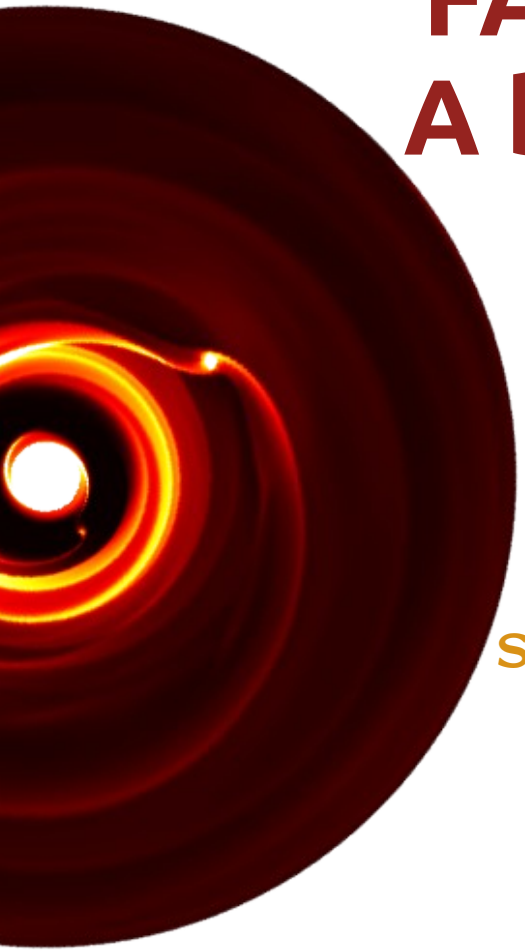

FARGO3D
A brief introduction

Numerical Astrophysics Workshop
Ordibehesht 9-11, 1404
Tehran, SOA, IPM

Sareh Ataiee

Ferdowsi University
of Mashhad

FARGO3D

https://github.com/FARGO3D/fargo3d

FARGO3D / **fargo3d**

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fargo3d Public

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main | 1 Branch | 2 Tags | Go to file t | Add file | Code

pbllambay fix non initialized viscosity coefficient for cylindrical runs with c... f359328 · 4 months ago | 51 Commits

in	Merged in release/public (pull request #9)	7 years ago
planets	fargo3d 1.3	7 years ago
scripts	Revived old capability 'make blocks' (#12)	last year
setups	Merged in feature/nonuniform (pull request #31)	2 years ago
src	fix non initialized viscosity coefficient for cylindrical runs ...	4 months ago
std	adding JOBS to the defaultflags file (#4)	last year
test_suite	Python 2 and 3 compatibility and bug with MonCounter r...	6 years ago
utils	auto determine cuda sm	5 years ago
.gitignore	Python 2 and 3 compatibility and bug with MonCounter r...	6 years ago
Makefile	Fixed invocation of scripts/blocks.py in main Makefile (#1...	8 months ago
README.md	Update README.md (#3)	last year
license.txt	fargo3d 1.3	7 years ago

README | GPL-3.0 license

About

A versatile multifluid HD/MHD code that runs on clusters of CPUs or GPUs, with special emphasis on protoplanetary disks.

hpc | parallel-computing | astrophysics | gpu-computing | mpi-applications | hydrodynamics | planets | n-body | magnetohydrodynamics | protoplanetary-disks

Readme
GPL-3.0 license
Activity
Custom properties
20 stars
2 watching
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Report repository

Contributors 3

pbllambay Pablo Benítez-Llambay

fmasset

FARGO3D

https://github.com/FARGO3D/fargo3d

FARGO: Fast Advection in Rotating Gaseous Objects (Masset 2000)

FARGO3D

https://github.com/FARGO3D/fargo3d

FARGO: Fast Advection in Rotating Gaseous Objects (Masset 2000)

FARGO3D: the 3D successor of FARGO (Benítez- Llambay 2016)

FARGO3D

https://github.com/FARGO3D/fargo3d

FARGO: Fast Advection in Rotating Gaseous Objects (Masset 2000)

FARGO3D: the 3D successor of FARGO (Benítez- Llambay 2016)

- Finite difference explicit Eulerian fixed grid code
- Cartesian, cylindrical or spherical geometry
- Multifluid capability (gas and different dust sizes)
- HD and MHD
- 5^{th} order Runge-Kutta N-body solver

FARGO3D

https://github.com/FARGO3D/fargo3d

We assume you have already read document and

- installed FARGO3D with the mentioned correction
- have fargo3dplot and managed to import it
- had a look at the structure of the code

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```
arch   fargo3d   license.txt   outputs   README.md   setups   std          utils
bin    in        Makefile      planets   scripts     src      test_suite
```

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Our problem → Setup files → Parallel or Serial → Make and Run → Read the outputs → Analyse

FARGO3D

https://github.com/FARGO3D/fargo3d

Our problem → **Setup files** → Parallel or Serial → Make and Run → Read the outputs → Analyse

Units:

- MKS: all quantities must be given in MKS
- CGS: all quantities must be given in CGS
- Scale-free (default): G=1, M_*=1, R_0=1 ⇒ T= 2π

FARGO3D

https://github.com/FARGO3D/fargo3d

Our problem → **Setup files** → Parallel or Serial → Make and Run → Read the outputs → Analyse

There are four main setup files:

- setups/<setup_name>/<setup_name>.opt
- setups/<setup_name>/<setup_name>.par
- planets/<planet_name>.cfg
- setups/<setup_name>/<setup_name>.bound

FARGO3D

https://github.com/FARGO3D/fargo3d

<setup_name>.opt

```
11  FLUIDS := 0
12  NFLUIDS = 1
13  FARGO_OPT += -DNFLUIDS=${NFLUIDS}
14
15  #Monitoring options
16  MONITOR_SCALAR = MASS | MOM_X | TORQ
17  MONITOR_Y_RAW  = TORQ
18
19  #Damping zones in the active mesh
20
21  FARGO_OPT += -DSTOCKHOLM
22
23  FARGO_OPT +=  -DX
24  FARGO_OPT +=  -DY
25
26  #Equation of State
27  FARGO_OPT +=  -DISOTHERMAL
28
29  #Coordinate System.
30  FARGO_OPT +=  -DCYLINDRICAL
31
32  #Legacy files for outputs
33  FARGO_OPT += -DLEGACY
34
35  FARGO_OPT += -DPOTENTIAL
36
37  FARGO_OPT += -DALPHAVISCOSITY
```

de Val-Borro+2006

FARGO3D

https://github.com/FARGO3D/fargo3d

<setup_name>.par

```
### Mesh parameters

Nx          256     Azimuthal number of zones
Ny          128     Radial number of zones
Xmin        -3.14159265358979323844
Xmax        3.14159265358979323844
Ymin        0.4     Inner boundary radius
Ymax        2.5     Outer boundary radius
OmegaFrame  1.0005  Angular velocity for the frame of reference (If Frame is F).
Frame       C       Method for moving the frame of reference

### Output control parameters

DT          0.314159265359  Physical time between fine-grain outputs
Ninterm     20              Number of DTs between scalar fields outputs
Ntot        1000            Total number of DTs

OutputDir   @outputs/test1

### Plotting parameters

PlotLog     yes
Spacing     Log
```

x is ϕ
y is r

log only in r

FARGO3D

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<setup_name>.par

```
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DT          0.314159265359  Physical time between
Ninterm     20              Number of DTs between
Ntot        1000            Total number of DTs

OutputDir   @outputs/test1

### Plotting parameters

PlotLog     yes
Spacing     Log
```

dt: time-step
DT: between two dots
Ninterm×DT: one output
Ntot/Ninterm: final output

Put your knowledge in practice using FARGO3D

<setup_name>.bound

```
#Boundaries configuration file for fargo.bound
#-----------------------------------------------

Density:
    Ymin: KEPLERIAN2DDENS
    Ymax: KEPLERIAN2DDENS

Vx:
    Ymin: KEPLERIAN2DVAZIM
    Ymax: KEPLERIAN2DVAZIM

Vy:
    Ymin: ANTISYMMETRIC
    Ymax: ANTISYMMETRIC

```

FARGO3D

https://github.com/FARGO3D/fargo3d

<setup_name>.par

```
Setup           test1

### Disk parameters

AspectRatio     0.05                Thickness over Radius in the disc
Sigma0          6.3661977237e-4
Alpha           1.0e-4
SigmaSlope      1.5
FlaringIndex    0.5                 Slope for the aspect-ratio

# Radial range for damping (in period-ratios). Values smaller than one
# prevent damping.

DampingZone 1.15

# Characteristic time for damping, in units of the inverse local
# orbital frequency. Higher values means lower damping

TauDamp 0.3

### Planet parameters

PlanetConfig        planets/jupiter.cfg
ThicknessSmoothing  0.6
Eccentricity        0.0
ExcludeHill         no
IndirectTerm        Yes
```

$$h = \text{AspectRatio}\left(\frac{r}{R_0=1}\right)^{\text{FlaringIndex}}$$

FARGO3D

https://github.com/FARGO3D/fargo3d

<setup_name>.par

```
Setup           test1

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AspectRatio     0.05                Thickness over Radius in the disc
Sigma0          6.3661977237e-4     Surface Density at r=1
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$$\Sigma = \mathrm{Sigma0}\left(\frac{r}{R_0=1}\right)^{-\mathrm{SigmaSlope}}$$

FARGO3D

https://github.com/FARGO3D/fargo3d

<setup_name>.par

```
Setup           test1

### Disk parameters

AspectRatio     0.05                Thickness over Radius in the disc
Sigma0          6.3661977237e-4     Surface Density at r=1
Alpha           1.0e-4              Viscosity
SigmaSlope      1.5                 Slope for the surface density
FlaringIndex    0.5                 Slope for the aspect-ratio

# Radial range for damping (in period-ratios). Values smaller than one
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DampingZone 1.15

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$\nu = \alpha c_s H$

FARGO3D

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<setup_name>.par

```
Setup           test1

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IndirectTerm        Yes
```

$$y_{\mathrm{inf}} = \mathrm{Ymin}\ \mathrm{DampingZone}^{2/3}$$

$$y_{\mathrm{sup}} = \mathrm{Ymax}\ \mathrm{DampingZone}^{-2/3}$$

$$T_{\mathrm{damp\ in/out}} = \mathrm{TauDamp}\ T_{\mathrm{in/out}}$$

FARGO3D

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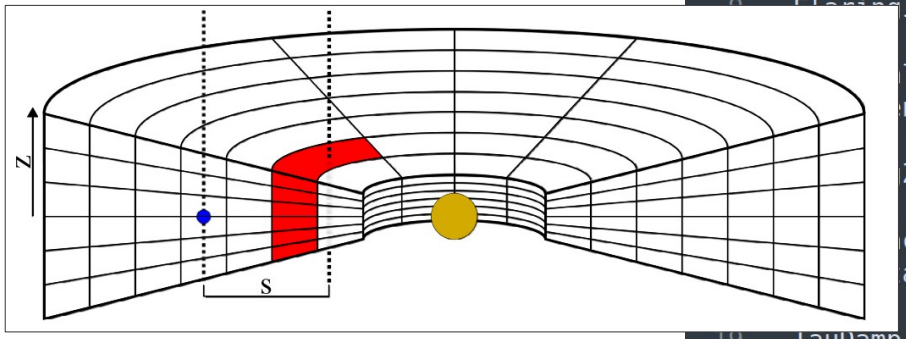
<setup_name>.par



Müller1+2012

```
Setup           test1

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AspectRatio     0.05                Thickness over Radius in the disc
Sigma0          6.3661977237e-4     Surface Density at r=1
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ThicknessSmoothing  0.6
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ExcludeHill         no
IndirectTerm        Yes
```

$$\phi_p = \frac{-GM_*}{\sqrt{r^2+\epsilon^2}}, \quad \epsilon = \text{ThicknessSmoothing } H$$

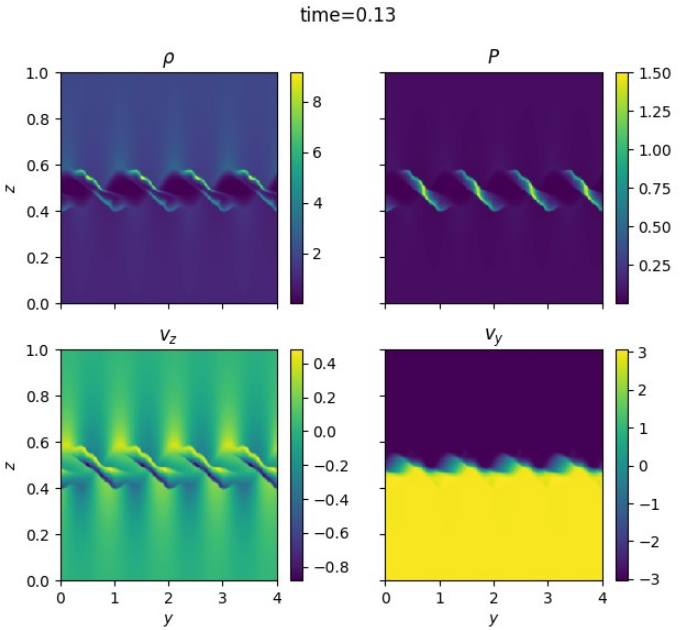
<planet_name>.cfg

```
1  ############################################################
2  #   Planetary system initial configuration
3  ############################################################
4
5  # Planet Name   Distance    Mass     Accretion  Feels Disk  Feels Others
6  Jupiter         1.0         0.001    0.0        NO          NO
7
```

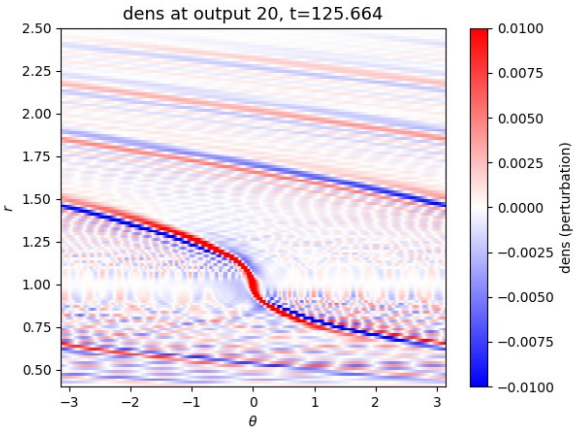
Our problem → Setup files → Parallel or Serial → Make and Run → **Read the outputs** → Analyse

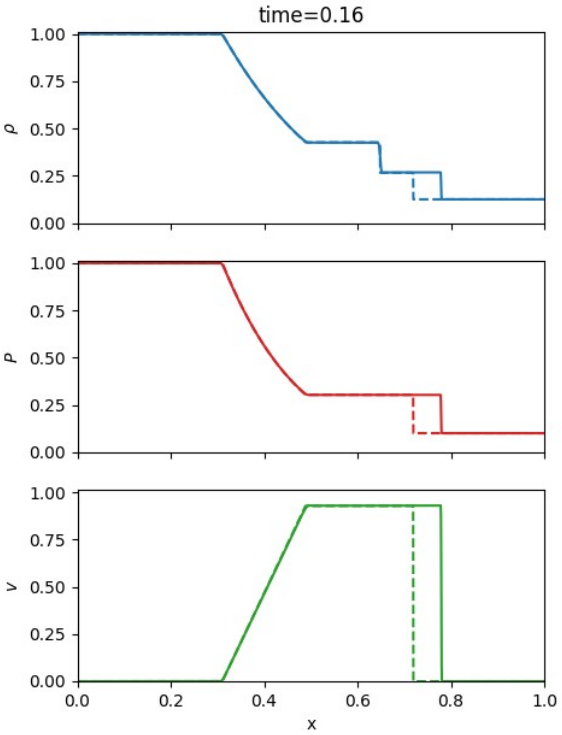
The outputs contains several types:

- Field files: binary, gas<field_name>%n.dat
- Planet files: ASCII
  - planet%n.dat (every field output)
  - bigplanet%n.dat, orbit%n.dat, tqwk%n.dat (every DT)
- Grid files: ASCII, domain_x.dat, domain_y.dat, domain_z.dat
- Monitoring files: ASCII and binary
- more...


time=0.13
ρ
P
v_z
v_y
z
y

Have fun!


dens at output 20, t=125.664
r
θ
dens (perturbation)


time=0.16
ρ
P
v
x