

FS x DYNAMICS

***BLUECFD-CORE STATUS REPORT
2024***

Customer: FOAM@Iberia

Date: 2024-10-04

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- blueCFD® is a registered trade mark by FS Dynamics Portugal.
- This offering is not approved or endorsed by OpenCFD Limited, producer and distributor of the OpenFOAM software via www.openfoam.com and owner of the OPENFOAM® and OpenCFD® trade marks.

Introduction to blueCFD-Core (1/5)

Why it exists

- OpenFOAM is mainly developed on Linux and the OpenFOAM Foundation does not support closed source operating systems.
- ESI-OpenCFD does provide cross-compilations of their releases for Windows, but it does not allow compiling directly on Windows (at least last time I checked).
- Most engineers work with Windows, including us at FS Dynamics.
- At the Lisbon office in Portugal:
 1. We develop software on Windows which interacts with OpenFOAM.
 2. Use blueCFD-Core for providing support to clients regarding OpenFOAM.

Introduction to blueCFD-Core (2/5)

What it is

- Open-source software project which provides source code and high-quality builds of OpenFOAM® technology for Microsoft Windows 10 and 11.
 - Older versions of blueCFD-Core will work on older versions of Windows.
 - Currently focused on the development line from the OpenFOAM Foundation.
- Additional tweaks, executables and scripts are also provided, to maintain usability.
- We also support porting related open-source projects whenever possible.
- Short-link to the project: <http://blueCFD.com/Core>

Introduction to blueCFD-Core (3/5)

Benefits

1. Used directly on Windows, by applications on Windows, accessing to the files directly.
 - Includes compiling code directly on Windows, e.g. *codeStream* feature.
 - No virtualization method is used, nor Cygwin.
2. Everything has been adapted to work directly on Windows. E.g.:
 1. Windows NTFS doesn't allow "Vector.H" and "vector.h" inside the same folder.
 2. blueCFD-Core provides "Vector.H" renamed as "Vector.T.H".
 - *Vector* is a C++ template class, *vector* a standard C++ class.
3. Works as if on Linux, through MSYS2, which provides the terminal-like interface.
 - Can run scripts as originally developed for OpenFOAM.
4. Easier to install than on Linux and WSL, especially for enterprise users.
5. Software can be developed to interact with OpenFOAM directly on Windows.





blueCFD-Core Project

Bringing OpenFOAM® technology to Windows.

- About
- News
- Funding
- Downloads
- User Guides
- Release Notes
- Frequently Asked Questions
- Issue Tracker
- Latest: [blueCFD-Core 2024-1](#)

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Sponsored by:  

Benefactors:  

Support drive 2024: help fund blueCFD-Core!

files for all

File name	# Accesses
File last updated (Y-M-D)	
blueCFD-Core-2024-1-win64-setup.exe 2024-08-19	1490
OpenFOAM-12.blueCFD-Core-12_ blueCFD-Core-2024-1.patch.gz 2024-08-19	37
ThirdParty-12.blueCFD-Core-12_ blueCFD-Core-2024-1.patch.gz 2024-08-19	40
blueCFD-Core-2020-1-win64-setup.exe 2021-04-13	38739
OpenFOAM-8.blueCFD-Core-8_ blueCFD-Core-2020-1.patch.gz 2021-04-13	370
ThirdParty-8.blueCFD-Core-8_ blueCFD-Core-2020-1.patch.gz 2021-04-13	240
blueCFD-Core-2017-2-win64-setup.exe 2018-02-27	102773
OpenFOAM-5.x.blueCFD-Core-5.x_ blueCFD-Core-2017-2.patch.gz 2018-02-27	1049
ThirdParty-5.x.blueCFD-Core-5.x_ blueCFD-Core-2017-2.patch.gz 2018-02-27	504
blueCFD-Core-2017-1-win64-setup.exe 2017-11-03	19506

Introduction to blueCFD-Core (5/5)

What it looks like

```
~/blueCFD/ofuser-of12/run/tutorials/incompressibleFluid/cavity
incompressibleDenseParticleFluid/ incompressibleFluid/ incompressibleVoF/
incompressibleDriftFlux/ incompressibleMultiphaseVoF/

Bruno Santos@pontadaareia MINGW64 OpenFOAM-12 ~/blueCFD/ofuser-of12/run
$ cd tutorials/incompressibleFluid/ca
cavity/ cavityCoupledU/

Bruno Santos@pontadaareia MINGW64 OpenFOAM-12 ~/blueCFD/ofuser-of12/run
$ cd tutorials/incompressibleFluid/cavity

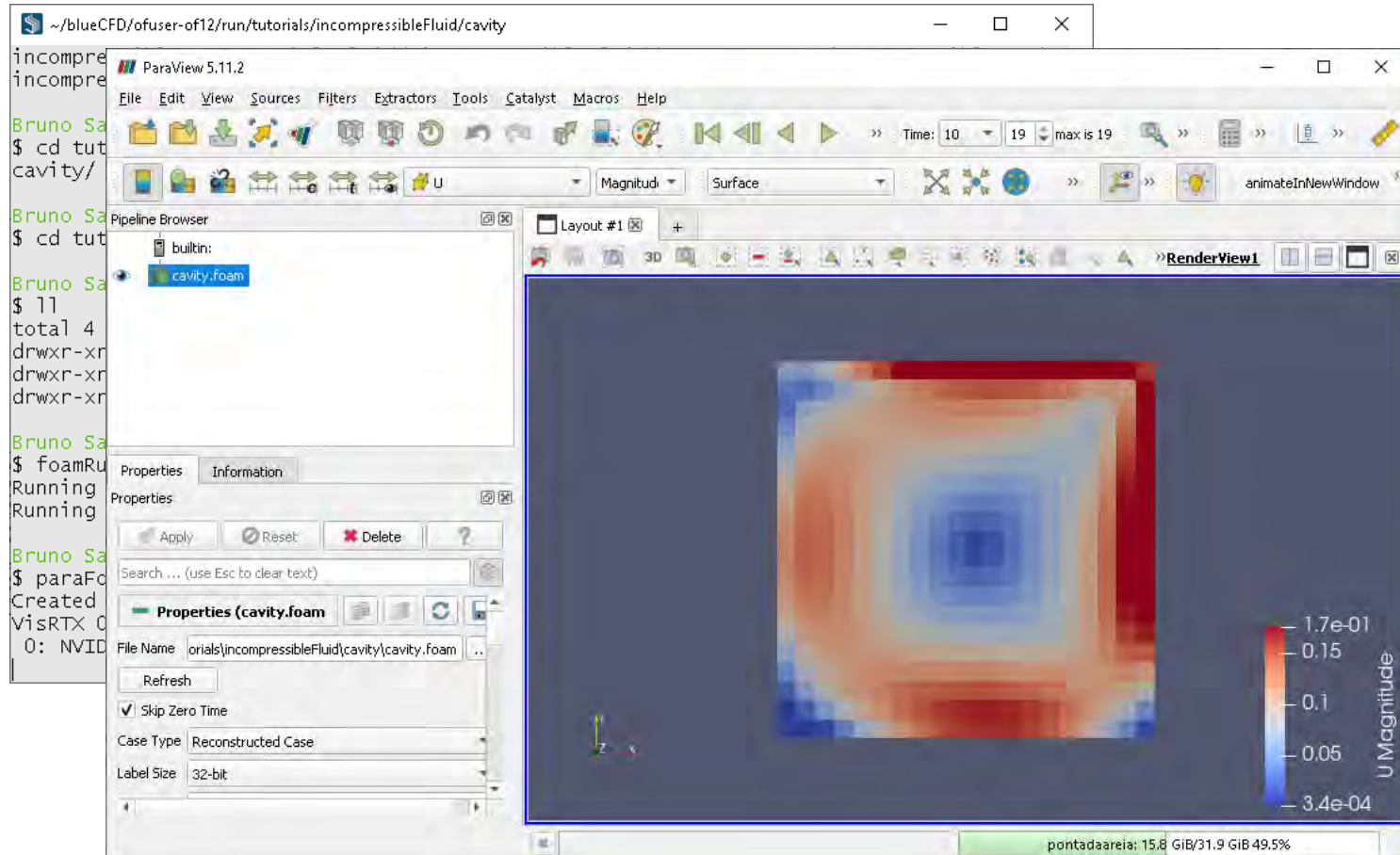
Bruno Santos@pontadaareia MINGW64 OpenFOAM-12 ~/blueCFD/ofuser-of12/run/tutorials/incomp
$ ll
total 4
drwxr-xr-x 1 Bruno Santos None 0 Aug 21 15:48 0
drwxr-xr-x 1 Bruno Santos None 0 Aug 21 15:48 constant
drwxr-xr-x 1 Bruno Santos None 0 Aug 21 15:48 system

Bruno Santos@pontadaareia MINGW64 OpenFOAM-12 ~/blueCFD/ofuser-of12/run/tutorials/incomp
$ foamRunTutorials
Running blockMesh on /home/ofuser/blueCFD/ofuser-of12/run/tutorials/incompressibleFluid/
Running foamRun on /home/ofuser/blueCFD/ofuser-of12/run/tutorials/incompressibleFluid/ca

Bruno Santos@pontadaareia MINGW64 OpenFOAM-12 ~/blueCFD/ofuser-of12/run/tutorials/incomp
$ paraFoam
Created temporary 'cavity.foam'
VisRTX 0.1.6, using devices:
 0: NVIDIA GeForce GTX 1070 Ti (Total: 8.6 GB, Available: 7.6 GB)
```

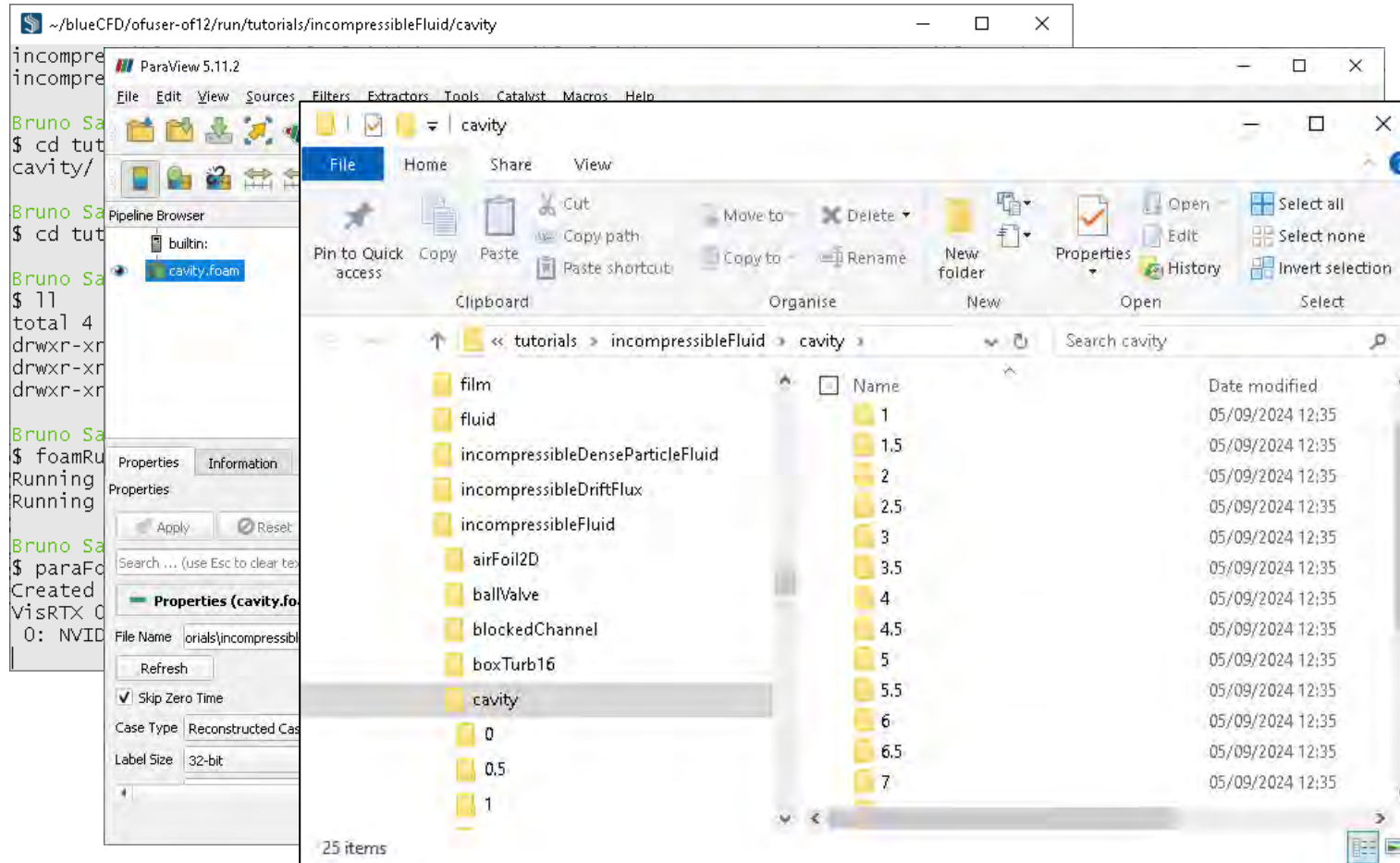
Introduction to blueCFD-Core (5/5)

What it looks like



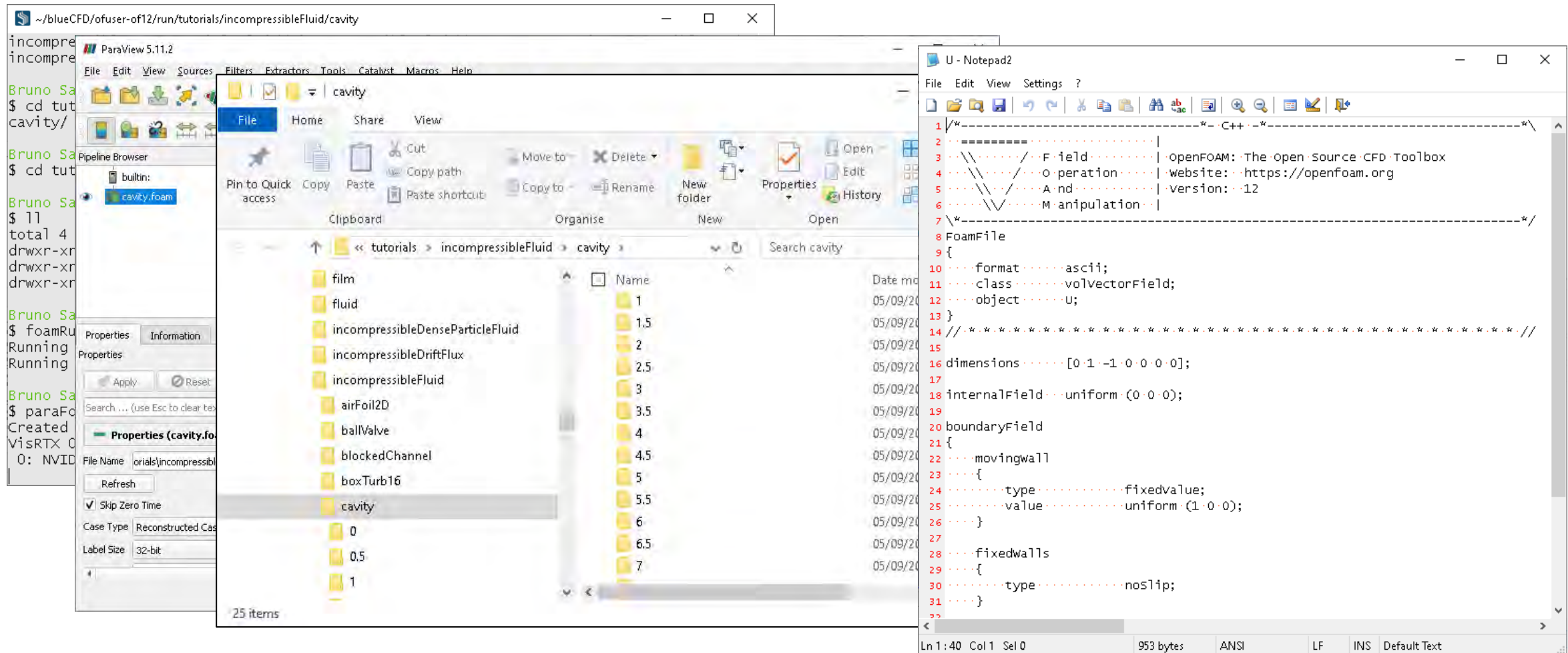
Introduction to blueCFD-Core (5/5)

What it looks like



Introduction to blueCFD-Core (5/5)

What it looks like



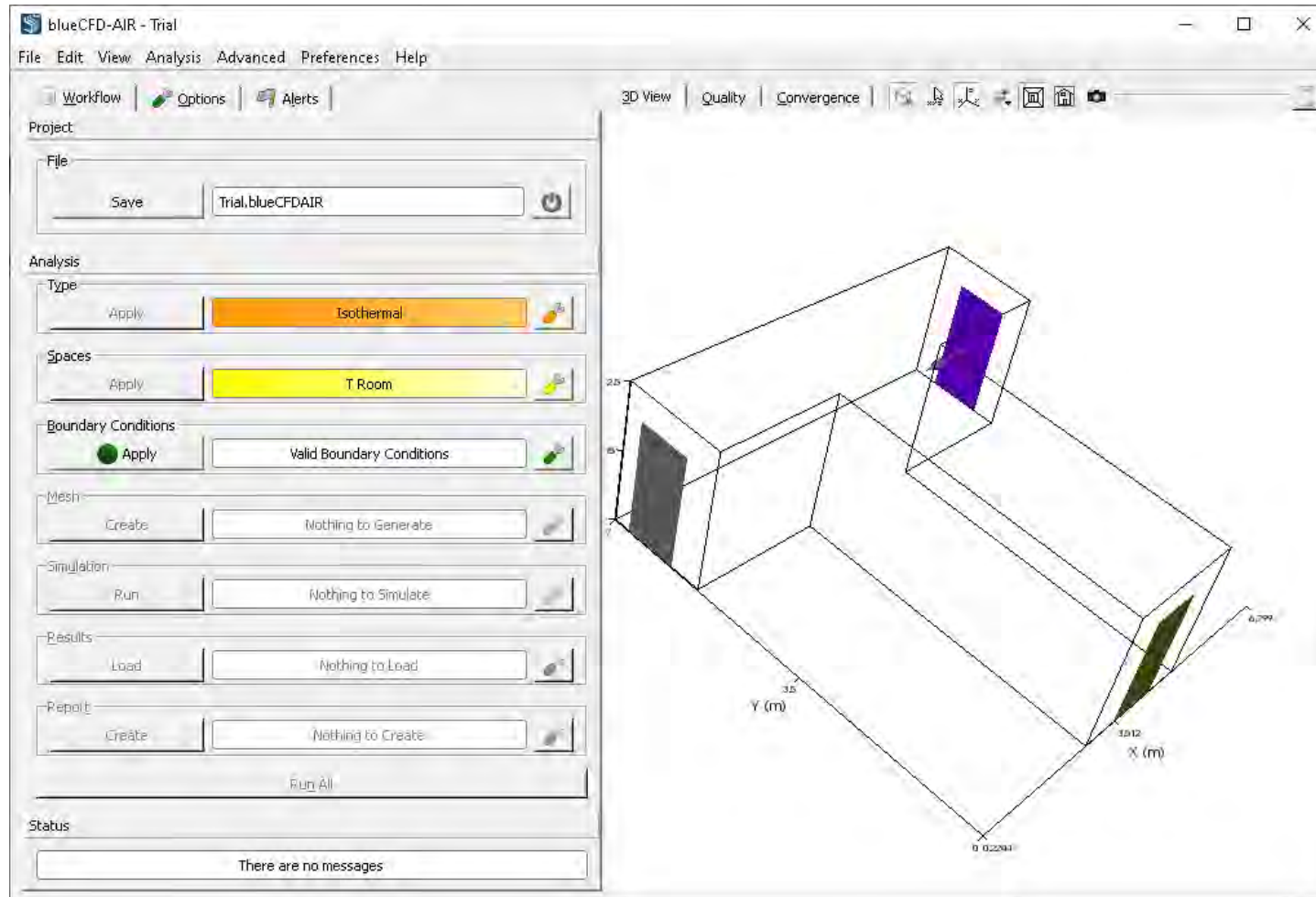
blueCFD-Core use cases (1/5)

Case #1: blueCFD-AIR

- blueCFD-AIR – <http://bluecfd.com/AIR>
- Our own GUI, oriented towards AEC users as well.
- Began development in 2009, along with blueCFD-Core.
- In 2016 was made free to the public, due to the lack of paying users and because we were developing blueCFD-Kernel since 2012.
- We own the source code, closed source.
- Can be adapted to fit customer's needs.

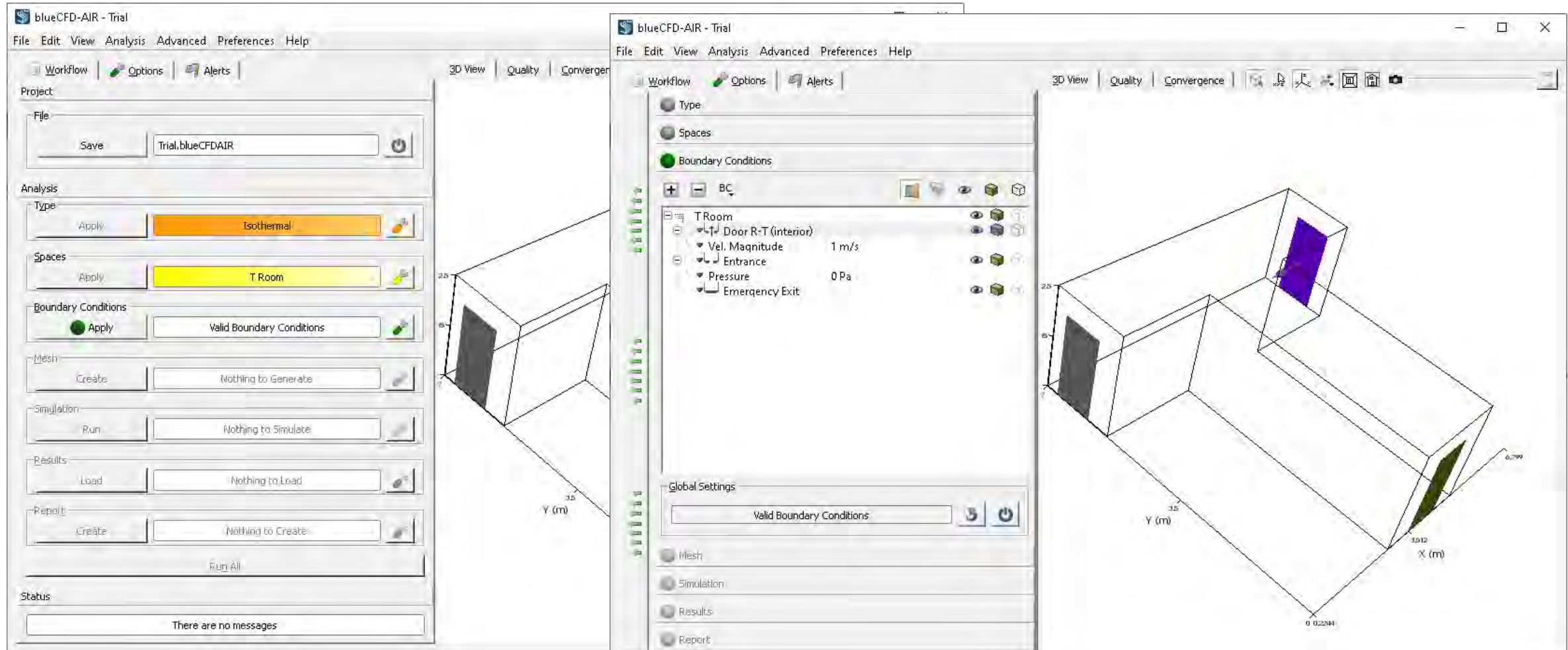
blueCFD-Core use cases (2/5)

Case #1: blueCFD-AIR



blueCFD-Core use cases (2/5)

Case #1: blueCFD-AIR



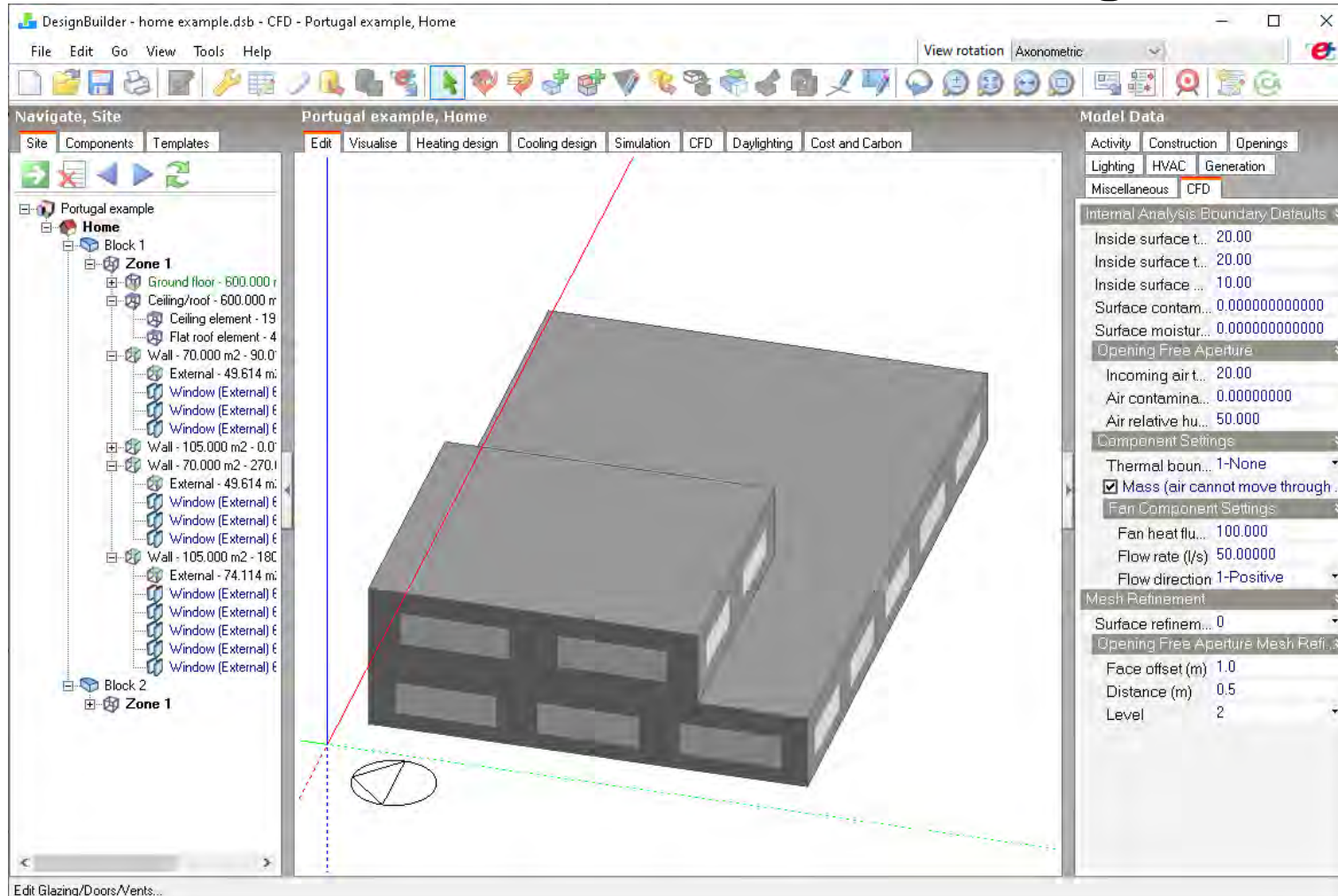
blueCFD-Core use cases (3/5)

Case #2: blueCFD-Kernel

- blueCFD-Kernel is developed at the Lisbon office.
- Middleware solution for engineering companies that perform software development and wish to integrate Computational Fluid Dynamics into their in-house applications.
- In practice, software which bridges between DesignBuilder and OpenFOAM.
- DesignBuilder:
 - Runs only on Windows.
 - Targets users in the fields of Architectural, Engineering and Construction.
 - <https://designbuilder.co.uk/>
 - Is our client.

blueCFD-Core use cases (4/5)

Case #2: blueCFD-Kernel hidden behind DesignBuilder



blueCFD-Core use cases (4/5)

Case #2: blueCFD-Kernel hidden behind DesignBuilder

The screenshot displays the DesignBuilder interface for a CFD simulation. On the left, a tree view shows the model structure for 'Portugal example, Home', including 'Block 1' and 'Zone 1' with various surfaces like 'Ground floor', 'Ceiling/roof', 'Ceiling element', 'Flat roof element', and multiple 'Wall' and 'Window' elements. The central 3D view shows a perspective rendering of a house with a red wireframe plane overlaid. On the right, the 'Edit Calculation Options' dialog is open, showing the 'General' tab with settings for 'Number of cores' (4), 'Write period' (250), and 'Turbulence Model' (2-Standard k-e). Below this, convergence criteria are listed, including 'Maximum iterations' (50), 'Relative tolerance' (0.000010), 'Relaxation factor' (0.700), and 'Maximum residual' (0.000001). To the right of the dialog is a 'Residuals' plot showing 'Normalised Residuals' on a logarithmic scale from 10^{-5} to 10^3 against 'Iteration' from 0 to 500. The plot includes lines for Mass, X-Velocity, Z-Velocity, Y-Velocity, Temperature, Turbulence KE, and Turbulence Diss. At the bottom, a status bar indicates 'Results available, but calculations not com...' and buttons for 'Reset', 'Pause', 'Help', 'Close', and 'Resume' are visible.

blueCFD-Core use cases (5/5)

Case #3: DHCAE and other GUIs

- DHCAE Tools GmbH is a German company oriented towards open-source CFD and support.
 - Were among the first adopters and currently are benefactors to the blueCFD-Core project.
 - CastNet - <https://www.dhcae-tools.com/CastNet.html> - a GUI by DHCAE for enabling engineers to access lower cost CFD software and support.
- CFD OF - <https://github.com/jaheyns/CfdOF> - an addon for FreeCAD, open-source.
- Eddy3D add-on for Rhino CAD: <https://www.eddy3d.com/> - Free but Rhino is commercial.
- MantiumFlow CFD Simulation Software - <http://mantiumflow.com> - commercial.
- Butterfly add-on for Rhino CAD: <https://www.ladybug.tools/butterfly.html> - commercial.

How it is developed and released (1/2)

1. Reference:

1. blueCFD-Core 2024-1 – 19th of August 2024, provides OpenFOAM 12.
2. Took ~120h, not including infrastructure.
3. More than half was for revising code changes in OpenFOAM from 2020 to 2024 and fixing issues.

2. Infrastructure (~80h to implement):

1. Synchronization bot on a Linux server, syncs up our modifications to OpenFOAM-dev and OpenFOAM 12.
 - Implemented in November 2023 and updated in June-August 2024.
 - It assisted us in code revising (#1.2).
2. Review daily/periodically any critical changes which the bot reports (~1 min/day, if nothing needs fixing).

3. Compiling/building is done manually on Windows.

How it is developed and released (2/2)

4. Run manually tutorial cases in test batches (4 min wall-clock per case).
5. Diagnose what doesn't work (compare with Linux) and fix+build it, then redo step #4.
6. For each major release:
 1. Manually update the installation scripts.
 2. Generate the installer.
 3. Test installer on a few machines and re-doing step #4 in it.
7. Publish it online:
 1. Release notes and news page.
 2. Upload installer and source code patch files.
 3. Update download page.
 4. Announcements online at Twitter, LinkedIn, CFD-Online and other forums.
 5. Send as newsletters to sponsors and interested people.

Limitations and solutions for those (1/3)

1. In blueCFD-Core 2024-1, one tutorial case (in >200) not working properly on Windows.
 - Need time/funding to diagnose why it fails and then fix it.
2. The sync, build and release process is still slow.
 - The plan:
 1. Automate testing and comparing results on Linux vs Windows.
 2. Generate packages for MSYS2, for updates and releases (as done for Linux distributions).
 3. Automate the generation of the installers for Windows.
 - This should reduce annual cost to 40h/year, allowing yearly/monthly releases.
 - Versus >240h/release every 2-4 years.
 - **Funding is the critical factor here.**

Limitations and solutions for those (2/3)

3. Performance can be 5 to 50% slower than running on Linux.
 - We have a proof-of-concept for fixing this and be on-par with Linux, pending funding.
4. Cannot use OpenFOAM's own reader for ParaView.
 - ParaView's built-in *.foam* reader works most of the time.
 - Requires building ParaView on MSYS2 or Visual Studio, which takes time/funding.
5. Community provided addons require modifications to compile on blueCFD-Core.
 - We have a script, but it's not ready for public use.

Limitations and solutions for those (3/3)

Status on our funding vs development effort:

Funding Goals	Task	Description	Effort (Euro)	Funding (%)	Progress (%)
First	1	Synchronise our developments with OpenFOAM-dev, making it build and run-on Windows.	900	100	100
	2	Automate the sync up between our developments and OpenFOAM-dev, to be able to have weekly builds of it made available automatically.	2700	43.5	90
	3	Automate of testing whether the weekly builds are working as intended.	900	0	0
	4	Monitor automation's results throughout 2024.	900	0	50
Second	5	Deliver the automated builds as a pacman repository for MSys2, to make it easier for people to stay in-sync with OpenFOAM-dev on Windows.	1350	0	0
	6	Streamline the build+release system of the blueCFD-Core installers.	1350	0	20
Third	7	Fixing reported bugs and those caught during the tasks above.	1800	0	90
Fourth	8	Release blueCFD-Core 2024-1 with OpenFOAM 12.	2700	100	100
Fifth	9	Add OpenFOAM 12 to the automation loop for a monthly release.	1800	0	40
Total			14400	33	63

How you can help

1. If you can contribute in any way, either through funding or collaboration, let us know!
2. If OpenFOAM is an option for a client or a new project, then advertise that we have blueCFD-Core: <http://bluecfd.com/Core>
3. Feedback on existing users or potential users is very welcome:
 1. If you want to replace a CFD workflow by using OpenFOAM instead of Fluent and/or Star-CCM+ on Windows.
 2. Need OpenFOAM yourself on Windows and don't want the hassle of handling WSL or virtual machines.
 3. If you or your client need some kind of dedicated GUI or workflow on Windows or Linux.
4. We will be publishing announcements on LinkedIn at <http://bluecape.com.pt/LinkedIn> – like and repost our announcements if you want to spread the news!