

Una introducción a la caja de herramientas DUNE Numerics para la solución de modelos matemáticos



Webinar 13 de Julio de 2021

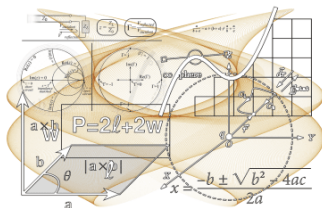
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Universidad Nacional de Ingeniería, Perú



Las matemáticas en la vida real

Introducción básica al modelamiento matemático

John Jairo Leal Gómez / Juan Pablo Cardona Guío



Dirección de Investigación y Extensión
Vicerrectoría
Sede Palmira



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CAPÍTULOS:

1. Introducción a los números reales \mathbb{R} .
2. Introducción a las funciones.
3. La derivada.
4. Modelamiento matemático.
5. Anexos.

4.3 Situaciones cotidianas

En primer lugar, se muestran “expresiones” de situaciones cotidianas con sus respectivas representaciones como funciones y sus derivadas.

4.3.1 Encender la luz



Figura 4.3.
Encender la luz







La acción de encender la luz, como en la figura 4.3, se puede escribir matemáticamente como el cambio en la posición del *switch* P como variable independiente o causa del fenómeno, y el efecto se puede ver en el cambio de la intensidad lumínica I . Esto quiere decir que la intensidad lumínica es una función de la posición del *switch* $I(P)$. La variación se puede escribir como:

$$\frac{dI}{dP}$$

4.1



Distributed and Unified Numerics Environment (DUNE)

- ▶ Software de código abierto bajo la licencia GNU General Public Licence 2  Free as in Freedom.
- ▶ Disponible en macOS, Debian , Ubuntu , openSUSE , Arch Linux  y FreeBSD .
- ▶ Conjunto de bibliotecas C++ con enlaces a Python.
- ▶ Utilizado en la resolución de ecuaciones diferenciales parciales e implementación de métodos basados en mallas, por ejemplo diferencias finitas, elementos finitos o volúmenes finitos.

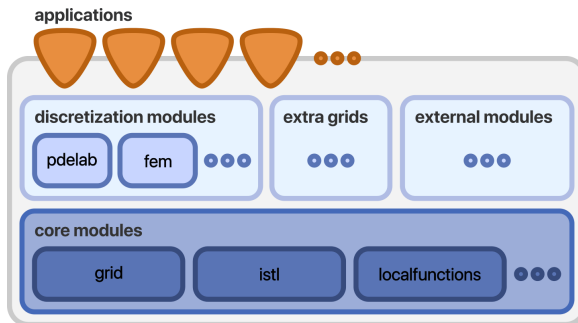


Figura: Tomado de <https://dune-project.org>.

Proyectos que emplean DUNE

- ▶ <https://dune-project.org/about/dune>
- ▶ <https://dumux.org>
- ▶ <https://opm-project.org>
- ▶ <https://precice.org>
- ▶ <https://www.zib.de/projects/kaskade7-finite-element-toolbox>

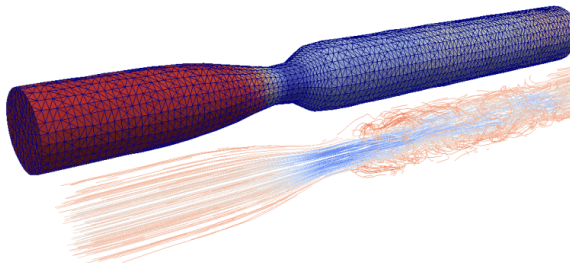


Figura: Tomado de <https://dune-project.org>.

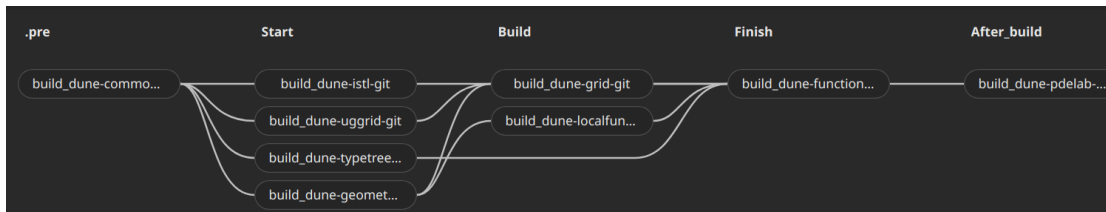


Figura: Tomado de

<https://gitlab.com/dune-archiso/repository/dune-archiso-repository-pdelab-git/-/pipelines>

dune-common Clases fundamentales e infraestructura para la construcción del sistema.

dune-geometry Elementos de referencia, métodos de cuadraturas y transformaciones geométricas.

dune-grid Interfaces con las mallas (ALUGrid, UGGrid, AlbertaGrid, YaspGrid), construcción y visualización.

dune-istl Biblioteca de solucionadores iterativas de plantillas, clases genéricas de matrices/vectores dispersos, solucionadores

dune-localfunctions Interface genérica para funciones de elementos finitos.

```
dune-fem
├── dune-grid
│   └── dune-geometry
│       └── dune-common
```

```
dumux
├── dune-istl
├── dune-localfunctions
├── vc
├── psurface
├── superlu
├── arpack++
├── suitesparse
├── dune-alugrid
├── dune-subgrid
├── fmt
└── opm-common
```

```
opm-upscaling
├── opm-grid
│   └── opm-common
│       ├── dune-grid
│       │   └── dune-geometry
│       ├── dune-istl
│       └── boost
```

```
opm-models
├── opm-material
│   └── opm-common
│       ├── dune-grid
│       │   └── dune-geometry
│       ├── dune-istl
│       └── boost
```

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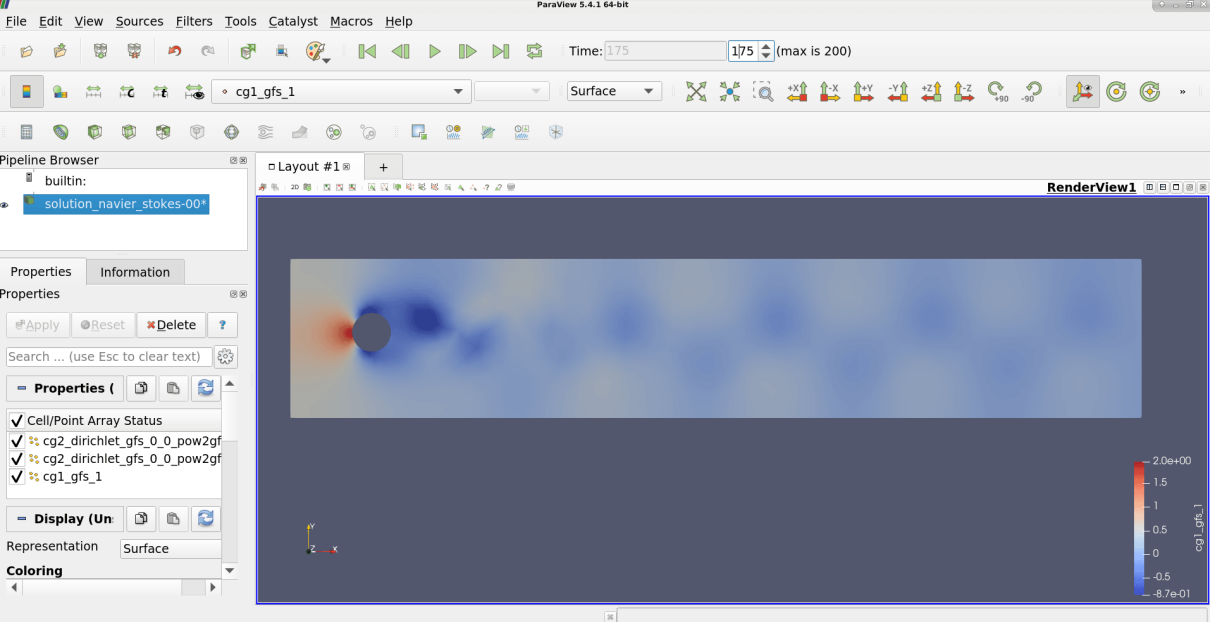
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Built with [Sphinx](#) using a [theme](#) provided by [Read the Docs](#).

Listado: Programa dune-basics.cc.

```
#ifdef HAVE_CONFIG_H
#include "config.h"
#endif
#include <iostream>
#include <dune/common/parallel/mpihelper.hh> // An initializer of MPI
#include <dune/common/exceptions.hh>        // We use exceptions

int main(int argc, char **argv)
{
    try
    {
        // Maybe initialize MPI
        Dune::MPIHelper &helper = Dune::MPIHelper::instance(argc, argv);
        std::cout << "Hello World! This is dune-basics." << std::endl;
        if (Dune::MPIHelper::isFake)
            std::cout << "This is a sequential program." << std::endl;
        else
            std::cout << "I am rank " << helper.rank() << " of " << helper.size()
                      << " processes!" << std::endl;
        return 0;
    }
    catch (Dune::Exception &e)
    {
        std::cerr << "Dune reported error: " << e << std::endl;
    }
    catch (...)
    {
        std::cerr << "Unknown exception thrown!" << std::endl;
    }
}
```



Grid Views: Adaptivity and Moving Domains

Dynamic Local Grid Refinement and Coarsening

Evolving Domains

Mean Curvature Flow

Using C++ Code Snippets

Discontinuous Galerkin Methods: DUNE-FEM-DG Module

USER PROJECTS

HP adaptive DG scheme for twophase flow problem

Virtual Finite Elements: the DUNE-VEM module

INFORMATION AND RESOURCES

Information for C++ Developers

How to showcase your own project

Notebooks and Scripts

Mesh Files used in the Examples

Citing this project

List of things that need doing...

```
[1]: import matplotlib
matplotlib.rc( 'image', cmap='jet' )
import math

from ufl import *
from dune.ufl import Constant, DirichletBC
import dune.ufl
import dune.geometry as geometry
import dune.fem as fem
from dune.fem.plotting import plotPointData as plot
import matplotlib.pyplot as pyplot
```

set up polynomial order and radius of reference surface

```
[2]: order = 2
R0 = 2.
```

We begin by setting up reference domain Γ_0 (`grid`), and the space on Γ_0 that describes $\Gamma(t)$ (`space`). From this we interpolate the non-spherical initial surface `positions`, and, then reconstruct `space` for the discrete solution on $\Gamma(t)$.

grid construction; dune grid format file

```
[3]: from dune.fem.view import geometryGridView
from dune.fem.space import lagrange as solutionSpace
from dune.alugrid import aluConformGrid as leafGridView
```



Finite Elements

As another example we solve the poisson equation

$$\begin{aligned} -\Delta u &= f && \text{in } \Omega, \\ u &= 0 && \text{auf } \partial\Omega \end{aligned}$$

in Python based on a simplicial Dune grid: `ALUConformGrid`.

```
In [2]: import time
import numpy
import math
```

Como primer paso construimos la grilla

```
In [3]: from dune.grid import cartesianDomain, gridFunction
from dune.alugrid import aluConformGrid
vertices = numpy.array([(0,0), (1,0), (1,1), (0,1), (-1,1), (-1,0), (-1,-1), (0,-1)])
triangles = numpy.array([(2,0,1), (0,2,3), (4,0,3), (0,4,5), (6,0,5), (0,6,7)])
aluView = aluConformGrid({"vertices": vertices, "simplices": triangles})
aluView.hierarchicalGrid.globalRefine(7)
```

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C++ review DUNE

Una organización donde compartir notas acerca de C++ con pdfs escritos en LaTeX.

[America](#)stackoverflow.com/c/cpp-review-dune[Repositories](#) 21[Packages](#)[People](#) 10[Teams](#) 1[Settings](#)

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Un repositorio donde compartir notas acerca de C++ con pdfs escritos en LaTeX.

Dockerfile

☆ 1

[hdnum](#)

Template

[dune-basics](#)

Template

An example module that says Hello World.

[github-starter-course](#)

Template

github-starter-course created by GitHub Classroom

[cpp-examples](#)

Template

Forked from igormcoelho-learning/autograding-example-cpp-catch

Example of C/C++ autograding with Catch2 library - GitHub Classroom

[sandbox](#)

Template

Forked from corneliusludmann/gitpod-playground

This repository intentionally left empty. It merely serves as an entry point for personal Gitpod experiments.

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dune-archiso

Archiso profile based on CyberOS with DUNE Numerics

Status: **Beta** Brought to you by: [carlosal1015](#)

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Linux

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This is a live USB containing a full operating system that can be booted, this means that you can use a USB stick to burn this image or virtualize it to Linux-KVM, QEMU, Virtualbox, VMWare, Hyper-V. We included the following repositories:

- Arch Linux Core [Official]
- Arch Linux Extra [Official]
- Arch Linux Community [Official]
- Arch Linux Multilib [Official]
- Arch4Edu [Third-party]
- Cyber [Third-party]
- Dune-archiso-repository-core [Third-party]
- Dune-archiso-repository-extra [Third-party]

In addition, we provide the packages of some modules of DUNE Numerics (version 2.7.1), DuMux (version 3.4) and the Open Porous Media (version 2021.04). The full list of packages is described in <https://dune-archiso.gitlab.io/packages>

Enjoy. I don't belong to dune-project. All the blame falls on me (github.com/carlosal1015).

Recommended Projects



Arm Mbed OS
Platform operating system designed for the Internet of...



Apache OpenOffice
The free and Open Source productivity suite



KeePass
A lightweight and easy-to-use password manager



Clonezilla
A partition and disk imaging/cloning program



7-Zip
A free file archiver for extremely high compression

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¡Muchas gracias!



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<http://dune-project.org/>

Presentación disponible en:

[https://cpp-review-dune.github.io/webinar/
slides.pdf](https://cpp-review-dune.github.io/webinar/slides.pdf)

Grabación disponible en:

<https://player.vimeo.com/video/572717824>

Dudas, sugerencias o preguntas a:

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