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

Alfaomega

Webinar 13 de Julio de 2021

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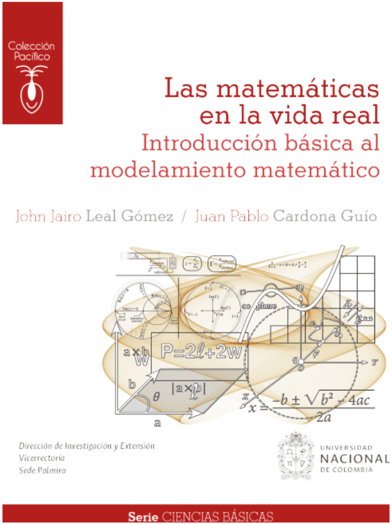
Presentación del libro



Capítulos:

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

Presentación del libro

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

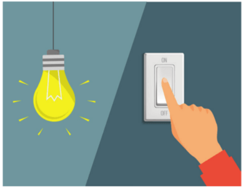


Figura 4.3.
Encender la luz

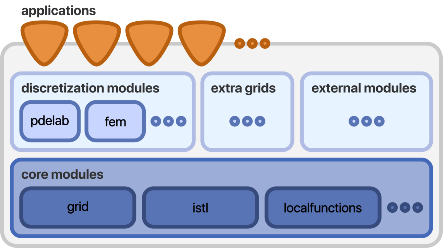
La acción de encender la luz, como en la figura 4.3, se puede escribir matemáticamente como el cambio en la posición del *switch* P como variable independiente o causa del fenómeno, y el efecto se puede ver en el cambio de la intensidad lumínica I. Esto quiere decir que la intensidad lumínica es una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

$$\frac{dI}{dP} \tag{4.1}$$

DUNE Numerics Project

Distributed and Unified Numerics Environment (DUNE)

- Software de código abierto bajo la licencia GNU General Public Licence 2.
- Disponible en macOS, Debian, Ubuntu, openSUSE, Arch Linux y FreeBSD.
- Conjunto de bibliotecas de plantillas en moderno con enlaces a.
- Implementación eficiente de las estructuras de datos y los algoritmos en interfaces abstractas.
- Para la resolución numérica de ecuaciones diferenciales parciales e implementación de esquemas basados en mallas, por ejemplo, *diferencias finitas*, *elementos finitos* o *volúmenes finitos*.



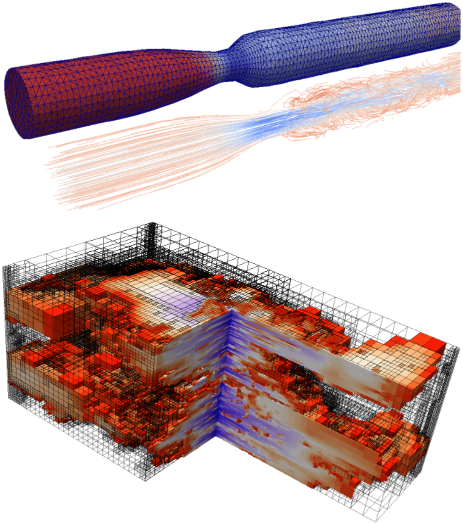
Origen: `https://dune-project.org/about/dune`.

Figura: Los binarios están disponible en el repositorio Arch Linux for Education (Jingbei Li, Carlos Aznarán y otros, octubre 2022).

DUNE Numerics Project

Proyectos que emplean DUNE

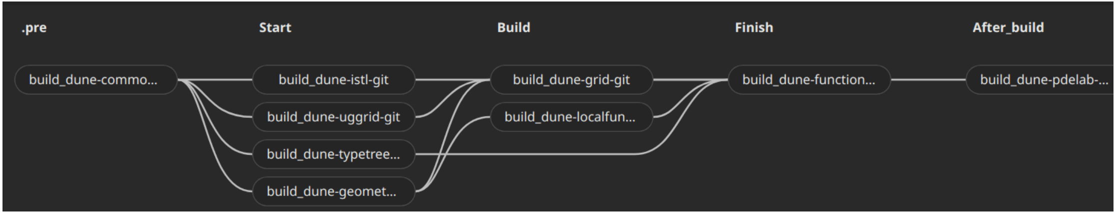
- https://dumux.org
- https://opm-project.org
- https://precice.org
- https://amdis.readthedocs.io
- https://github.com/parafields
- https://www.zib.de/projects/kaskade7-finite-element-toolbox



Origen: https://dune-project.org/gallery.

El DUNE verso: módulos

https://dune-project.org/groups/core



Origen: `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).

dune-istl Biblioteca de plantillas para solucionadores iterativos, clases genéricas de matrices/vectores dispersos.

dune-localfunctions Interface genérica para funciones de elementos finitos.

El DUNE verso: módulos
Dependencias de algunos módulos

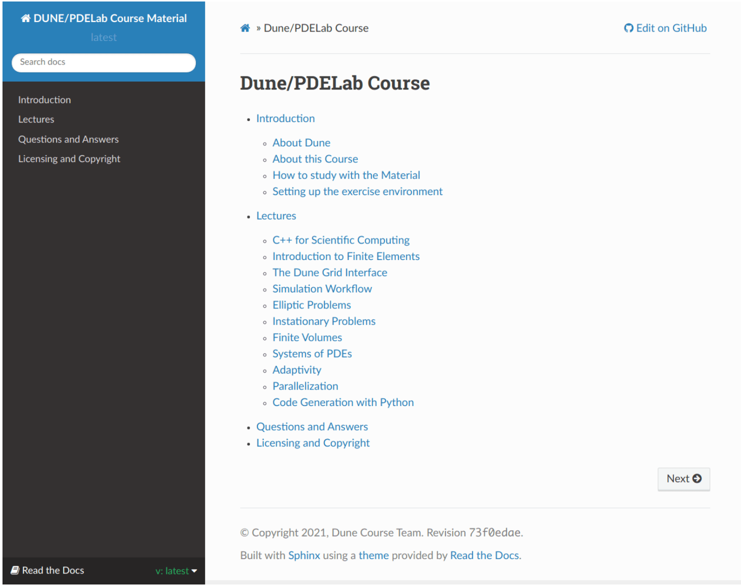
- dune-fem
  - dune-alugrid
  - dune-istl
  - dune-localfunctions
  - python-fenics-ufl
  - python-matplotlib
  - python-scipy
  - dune-polygongrid (opcional)
  - dune-spgrid (opcional)
  - eigen (opcional)
  - papi (opcional)
- opm-models
  - dune-alugrid
  - dune-localfunctions
  - opm-grid
    - opm-common
    - suitesparse
    - zoltan
  - dune-fem (opcional)

- dumux
  - dune-grid
  - dune-istl
  - dune-localfunctions
  - dune-alugrid (opcional)
  - dune-foamgrid (opcional)
  - dune-functions (opcional)
  - dune-mmesh (opcional)
  - dune-spgrid (opcional)
  - dune-subgrid (opcional)
  - opm-grid (opcional)

- dune-pdelab
  - arpack++
  - dune-alugrid
  - dune-functions
  - suitesparse
  - superlu
  - dune-multidomaingrid (opcional)

Curso de DUNE/PDELab 2021

https://dune-pdelab-course.readthedocs.io



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  - C++ for Scientific Computing
  - Introduction to Finite Elements
  - The Dune Grid Interface
  - Simulation Workflow
  - Elliptic Problems
  - Instationary Problems
  - Finite Volumes
  - Systems of PDEs
  - Adaptivity
  - Parallelization
  - Code Generation with Python
- Questions and Answers
- Licensing and Copyright

Next

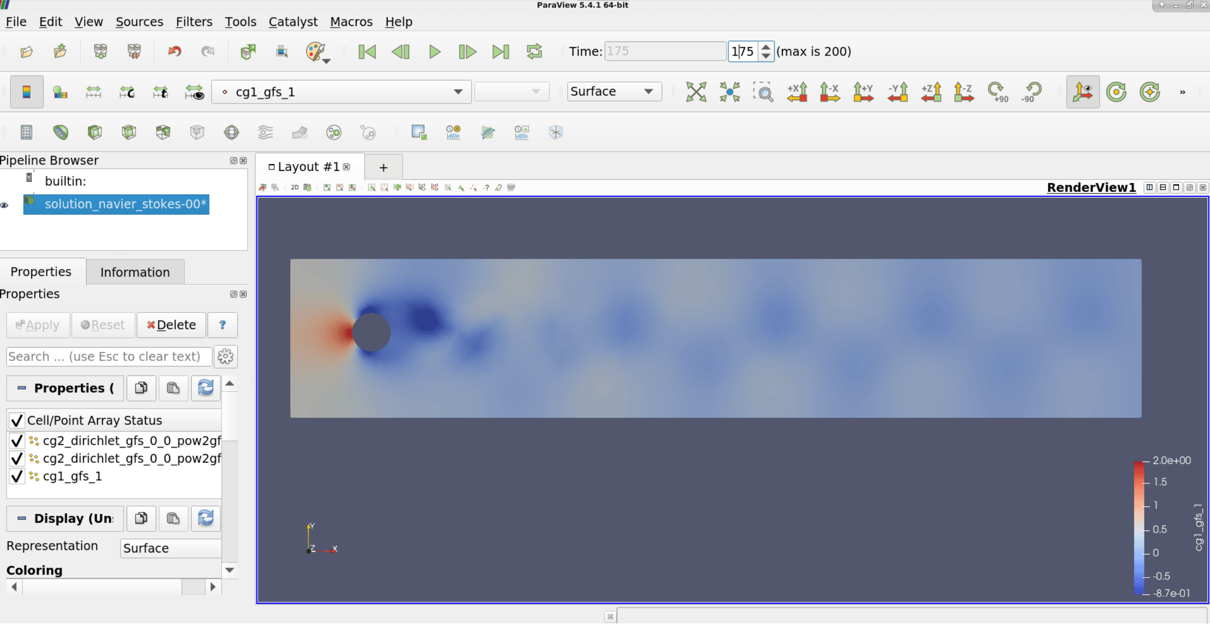
Built with Sphinx using a theme provided by Read the Docs.

Snippet en C++

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;
  }
}
```


ParaView 5.4.1 64-bit
File Edit View Sources Filters Tools Catalyst Macros Help
Time: 175
175
(max is 200)
cg1_gfs_1
Surface
Pipeline Browser
builtin:
solution_navier_stokes-00*
Properties
Information
Properties
Apply
Reset
Delete
Search ... (use Esc to clear text)
Properties (
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cg2_dirichlet_gfs_0_0_pow2gf
cg2_dirichlet_gfs_0_0_pow2gf
cg1_gfs_1
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Surface
Coloring
Layout #1
RenderView1
2.0e+00
1.5
1
0.5
0
-0.5
-8.7e-01
cg1_gfs_1

Snippet en Python

https://dune-project.org/sphinx/content/sphinx/dune-fem

[1]:
```
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 $\Gamma(t)$.

[3]:
```
from dune.fem.view import geometryGridView
from dune.fem.space import lagrange as solutionSpace
from dune.alugrid import aluConformGrid as leafGridView
gridView = leafGridView("sphere.dgf", dimgrid=2, dimworld=3)
space = solutionSpace(gridView, dimRange=gridView.dimWorld, order=order)
u = TrialFunction(space)
v = TestFunction(space)
x = SpatialCoordinate(space)
# positions = space.interpolate(x * (1 + 0.5*sin(2*pi*x[0]*x[1])* cos(pi*x[2])), name="posi
positions = space.interpolate(x * (1 + 0.5*sin(2*pi*(x[0]+x[1]))*cos(0.25*pi*x[2])), name="
surface = geometryGridView(positions)
space = solutionSpace(surface, dimRange=surface.dimWorld, order=order)
solution = space.interpolate(x, name="solution")
```

```
GridParameterBlock: Parameter 'bisectioncompatibility' not specified, defaulting to '0' (fa
```

Poisson equation.ipynb

File Edit View Run Kernel Tabs Settings Help

Finite Elements

As another example, we solve the Poisson equation

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

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

[1]:
```
import numpy as np
from dune.grid import cartesianDomain, gridFunction
from dune.alugrid import aluConformGrid
```

[2]:
```
vertices = np.array([(0, 0), (1, 0), (1, 1), (0, 1),
                     (-1, 1), (-1, 0), (-1, -1), (0, -1)])
triangles = np.array([(2, 0, 1), (0, 2, 3), (4, 0, 3),
                      (0, 4, 5), (6, 0, 5), (0, 6, 7)])
```

[3]:
```
aluView = aluConformGrid({"vertices": vertices, "simplices": triangles})
aluView.hierarchicalGrid.globalRefine(2)
```

```
DUNE-INFO: Generating dune-py module in /home/carlosal1015/.cache/dune-py
DUNE-INFO: Compiling HierarchicalGrid (new)
DUNE-INFO: Compiling ReferenceElements (new)
DUNE-INFO: Compiling ReferenceElements (new)
DUNE-INFO: Compiling ReferenceElements (new)
```

Simple 0 1 Python 3 (ipykernel) | Idle Mode: Command Ln 1, Col 1 Poisson equation.ipynb 0

C++ review DUNE

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

America stackoverflow.com/c/cpp-review-dune

Pinned repositories

Customize pinned repositories

introductory-review
Un repositorio donde compartir notas acerca de C++ con pdfs escritos en LaTeX.
Dockerfile 1

hdnum Template
C++

dune-basics Template
An example module that says Hello World.
TeX

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
C++

sandbox Template
Forked from corneliusludmann/gitpod-playground
This repository intentionally left empty. It merely serves as an entry point for personal Gitpod experiments.

Find a repository… Type Language Sort New

6 results for repositories written in **C++** sorted by **last updated** Clear filter

Top languages
C++ TeX Python
Jupyter Notebook Dockerfile

study-scientific-programming

Study of book Scientific Programming Advanced Concepts of Christian Engwer

dune-archiso

Archiso profile based on CyberOS with DUNE Numerics
Status: Beta Brought to you by: carlosal1015

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Linux

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).

Referencias

- Libros

Oliver Sander. *DUNE — The Distributed and Unified Numerics Environment*. First. Lecture Notes in Computational Science and Engineering 140. Springer International Publishing, 2020. ISBN: 978-3-030-59701-6. DOI: `10.1007/978-3-030-59702-3`.

- Artículos

Martin Alkämper, Andreas Dedner, Robert Klöfkorn y Martin Nolte. “The DUNE-ALUGrid Module”. En: *Archive of Numerical Software* 4.1 (2016). URL: `https://journals.ub.uni-heidelberg.de/index.php/ans/article/view/23252`.

Andreas Dedner y Martin Nolte. “The Dune Python Module”. En: *CoRR* abs/1807.05252 (2018). eprint: `1807.05252`. URL: `http://arxiv.org/abs/1807.05252`.

Peter Bastian et al. “The Dune framework: Basic concepts and recent developments”. En: *Computers & Mathematics with Applications* 81.1 (1 de ene. de 2021). Development and Application of Open-source Software for Problems with Numerical PDEs, págs. 75-112. ISSN: 0898-1221. DOI: `https://doi.org/10.1016/j.camwa.2020.06.007`.

Referencias

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Oliver Sander. *The Distributed and Unified Numerics Environment (DUNE)*. 12 de abr. de 2016. URL: http://congress.cimne.com/icme2016/admin/files/filepaper/p72.pdf (visitado 12-07-2021).

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Dune Course Team. *Dune/PDELab Course*. 22 de oct. de 2020. URL: https://dune-pdelab-course.readthedocs.io (visitado 26-06-2021).

Agradecimientos

¡Muchas gracias!

Alfaomega

UNIVERSIDAD NACIONAL DE COLOMBIA

Dune

http://dune-project.org/

Presentación disponible en:

https://cpp-review-dune.github.io/webinar/slides.pdf

Grabación disponible en:

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

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caznaranl@uni.pe