

Lisbon, Portugal  
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# A brief description of DualSPHysics

Prof. Moncho Gómez Gesteira – Ephyslab - UVigo



Environmental  
Physics  
Technologies | EPHYTECH

Universidade de Vigo

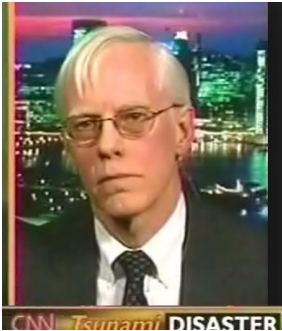


# SPHysics and DualSPHysics projects

# SPHysics code



DEVELOPED JOINTLY BY  
RESEARCHERS AT



**Johns Hopkins  
University  
(USA)**



**Universidade de  
Vigo  
(Spain)**

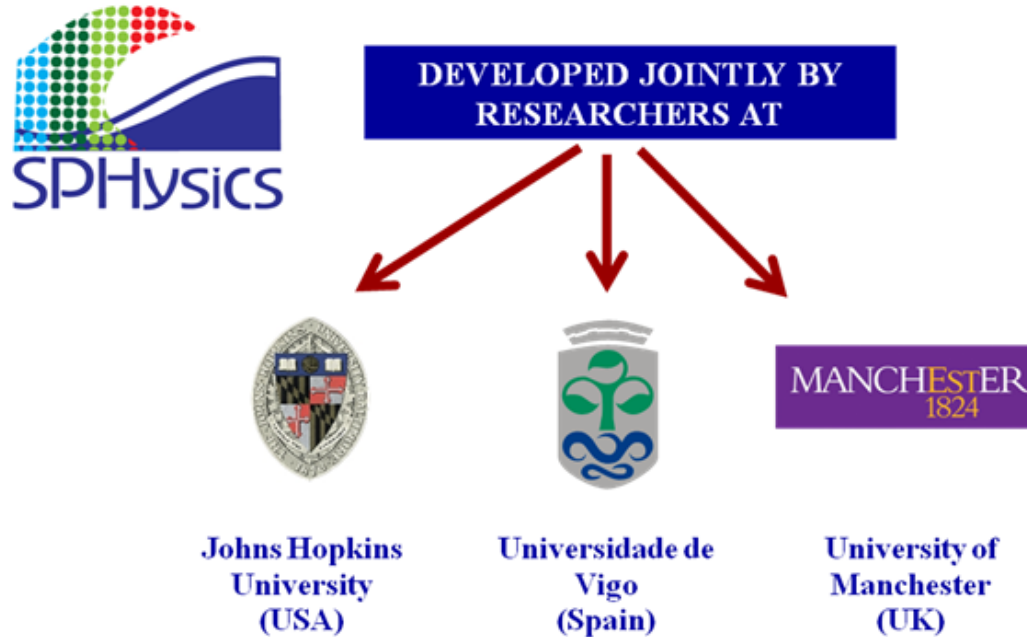
MANCHESTER  
1824



**University of  
Manchester  
(UK)**

SPHysics is a Smoothed Particle Hydrodynamics code primarily to study free-surface flow phenomena. It has been jointly developed by Johns Hopkins University (U.S.A.), the University of Vigo (Spain) and the University of Manchester (United Kingdom).

# SPHysics code

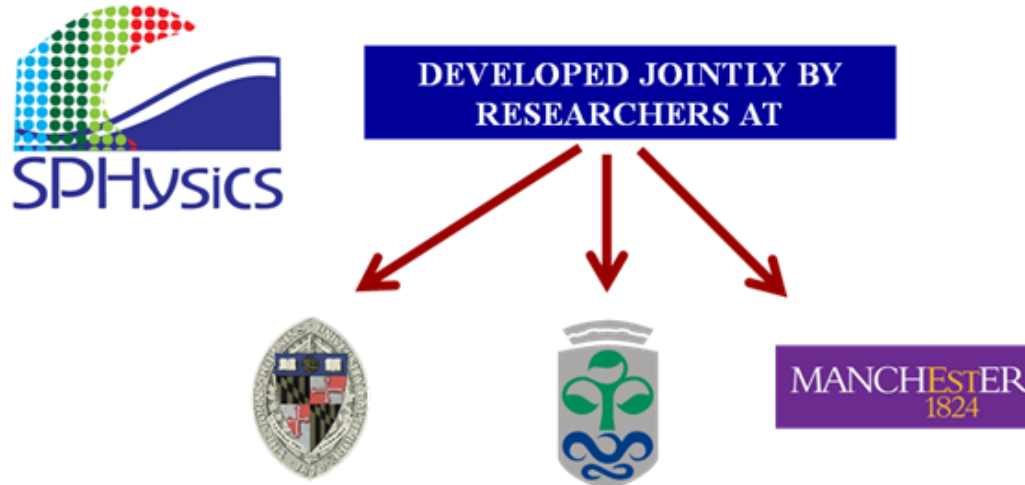


Model was accurate

High computational cost.

Only simplified cases could be studied

# SPHysics code



## Using a Three-Dimensional Smoothed Particle Hydrodynamics Method for Wave Impact on a Tall Structure

M. Gómez-Gesteira<sup>1</sup> and Robert A. Dalrymple, F.ASCE<sup>2</sup>

JOURNAL OF WATERWAY, PORT, COASTAL AND OCEAN ENGINEERING © ASCE / MARCH/APRIL 2004 /

179 cites (scopus)

# SPHysics code



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ELSEVIER

Coastal Engineering

Volume 53, Issues 2-3, February 2006, Pages 141-147



## Numerical modeling of water waves with the SPH method

As Prof. Jurjen Battjes has long worked in the area of waves and has inspired the authors throughout their careers, we dedicate this paper to him.

R.A. Dalrymple  , B.D. Rogers <sup>1</sup> 

375 cites (scopus)

# SPHysics code

The name was coined in 2007 by A. Crespo



| Name             | First Release | Language                    | Execution Device                                  |
|------------------|---------------|-----------------------------|---|
| SerialSPHysics   | August 2007   | Fortran                     | Single Processor                                  |
| ParallelSPHysics | January 2009  | Fortran, MPI                | Multi-core supercomputers                         |
| DualSPHysics     | January 2011  | C++, Open MP<br>CUDA<br>MPI | Multicore CPU<br>GPU<br>Multi-core supercomputers |



# DualSPHysics code



DualSPHysics

[FAQ](#) [References](#) [Downloads](#) [Validation](#) [Animations](#) [SPHysics](#) [GPU Computing](#)  
[Features](#) [WIKI](#) [GUI](#) [Visualization](#) [Developers](#) [Contact](#) [Forum](#) [News](#)



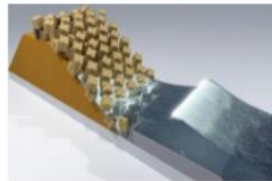
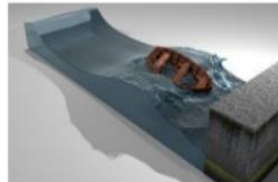
DualSPHysics is based on the Smoothed Particle Hydrodynamics model named SPHysics ([www.sphysics.org](http://www.sphysics.org)).

The code is developed to study free-surface flow phenomena where Eulerian methods can be difficult to apply, such as waves or impact of dam-breaks on off-shore structures. DualSPHysics is a set of C++, CUDA and Java codes designed to deal with real-life engineering problems.

Contact E-Mail: [dualsphysics@gmail.com](mailto:dualsphysics@gmail.com)

Youtube Channel: [www.youtube.com/user/DualSPHysics](http://www.youtube.com/user/DualSPHysics)

Twitter Account: [@DualSPHysics](https://twitter.com/DualSPHysics)



[www.dual.sphysics.org](http://www.dual.sphysics.org)

- **OPEN-SOURCE CODE**
- **AVAILABLE FOR FREE**
- **COLLABORATIVE PROJECT**
- **LGPL LICENSE**
- **HIGHLY PARALLELISED**
- **PRE- & POST-PROCESSING**
- **APPLIED TO REAL PROBLEMS**
- **JOURNAL PUBLICATIONS**
- **THESES**
- **COURSES**



# DualSPHysics code



| <b>Version</b> | <b># downloads</b> |
|----------------|--------------------|
| v1             | 701                |
| v2             | 6472               |
| v3             | 6982               |
| v4             | 8325               |

**TOTAL ~ 22,500 downloads**

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# DualSPHysics code



## **Industrial interest:**

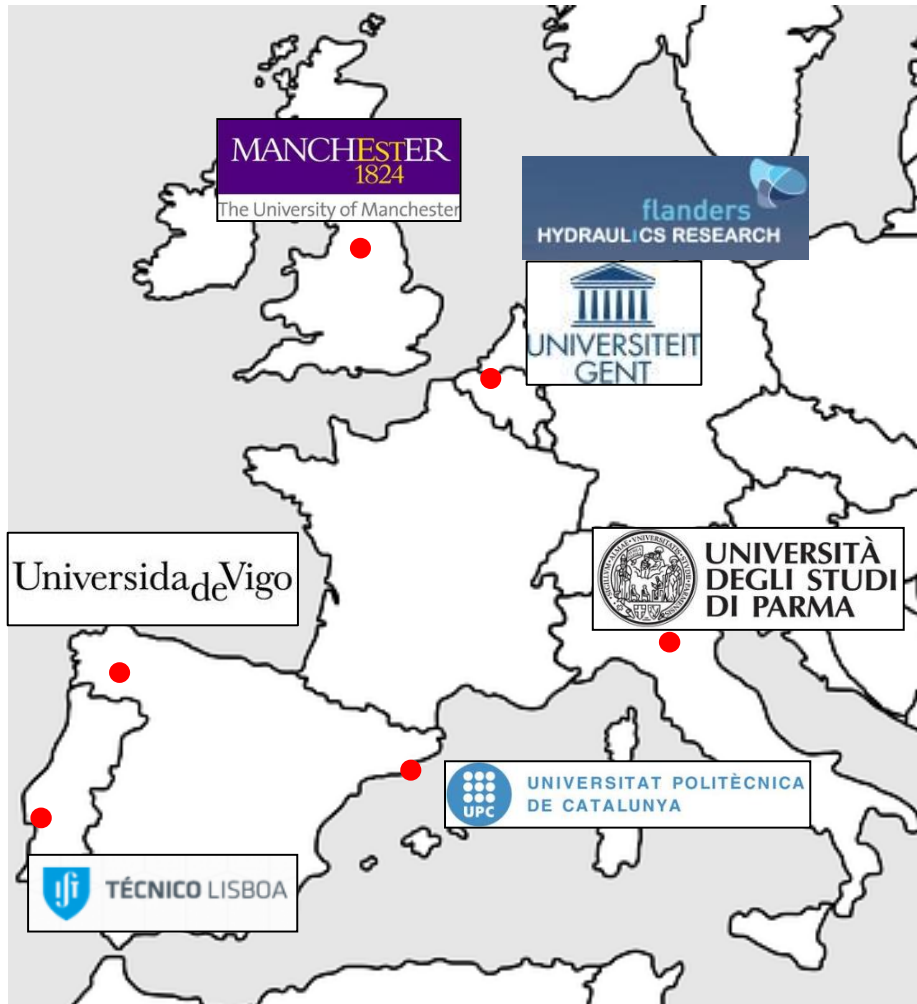
NASA JSC, BAE Systems, Volkswagen AG, McLaren Racing Ltd, Forum NOKIA, NVIDIA, AECOM, HDR Engineering, ABPmer, DLR, CFD-NUMERICS, BMT Group, Oak Ridge National Laboratory, Rainpower Norway, Shell Company, ABB, FEMTO Engineering, Williams F1, Audi, ...

## **Wave energy companies:**

American Wave Machines, Carnegie Wave Energy Ltd, Maine Marine Composites, National Renewable Energy Laboratory in U.S.A., Atria Power Corporation Ltd., Global Hydro Energy, WavePower

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# DualSPHysics



## DEVELOPERS:

Universidade de Vigo, Spain

Universidade de Vigo

The University of Manchester, UK



The University of Manchester

Università degli studi di Parma, Italy



UNIVERSITÀ DEGLI STUDI  
DI PARMA

Instituto Superior Tecnico, Lisbon, Portugal



Universiteit Gent - Flanders Hydraulics Research, Belgium





Ricardo Canelas  
Solid Objects (DEM & Chrono- Engine)



Georgios Fourtakas  
Multiphase: Fluid & Sediment



Athanasios Mocos  
Multiphase: Water & Air



The University of Manchester



UNIVERSITÀ DEGLI STUDI  
DI PARMA



**Renato Vacondio**

New challenges (Boundary conditions,  
Variable resolution)



UNIVERSITEIT  
GENT



flanders  
HYDRAULICS RESEARCH



**Corrado Altomare**

Waves and coastal engineering  
applications



**Jose M. Dominguez**  
Main developer

Universidade de Vigo



**Orlando G. Feal**  
Visualization  
Coupling with other models



**Alex Crespo**  
Floating offshore structures

## COLLABORATIONS:

Universidad Politécnica de Madrid, Spain



POLITÉCNICA

TECNALIA. Inspiring Business, Spain



Universitat Politècnica de Catalunya



UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH

Imperial College London, UK

Imperial College  
London

New Jersey Institute of Technology, USA



Universidad de Guanajuato, Mexico



UNIVERSIDAD  
DE GUANAJUATO



# DualSPHysics code



LGPL (Lesser General Public License) can be used in **commercial** applications

Software can be incorporated into both:

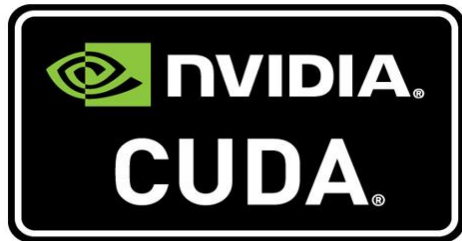
- free software and
- proprietary software


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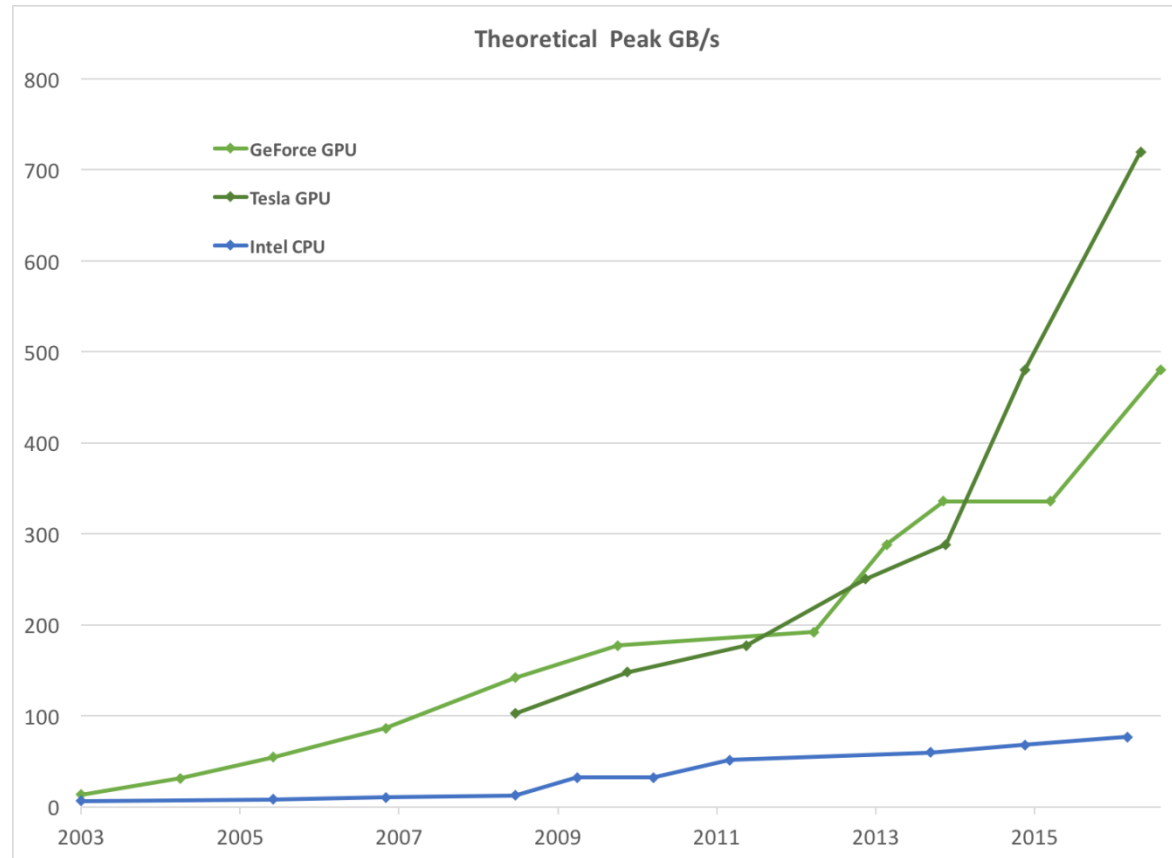
GPU  CPU  
x100

# DualSPHysics



## Graphics Processing Units (GPUs)

- powerful parallel processors
- designed for graphics rendering
- their computing power has increased much faster than CPUs.



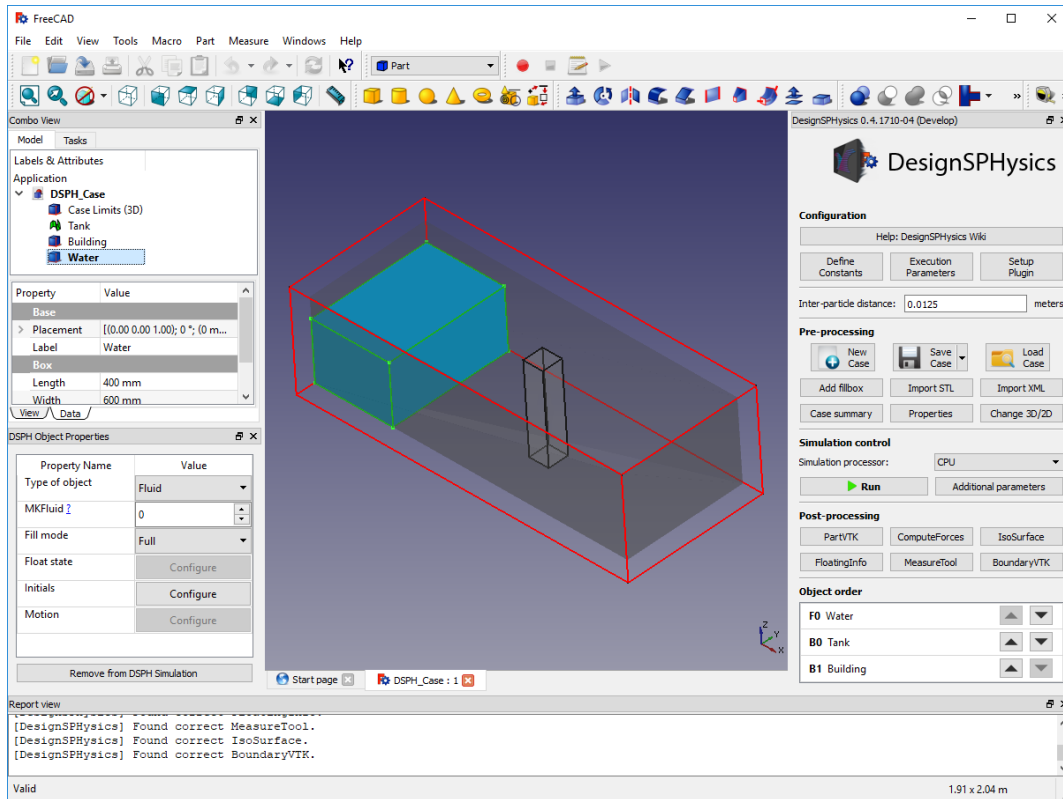
**Advantages:** GPUs provide the necessary power with very low cost and without expensive infrastructures.

**Drawbacks:** An efficient and full use of the capabilities of the GPUs is not straightforward.

# DualSPHysics code

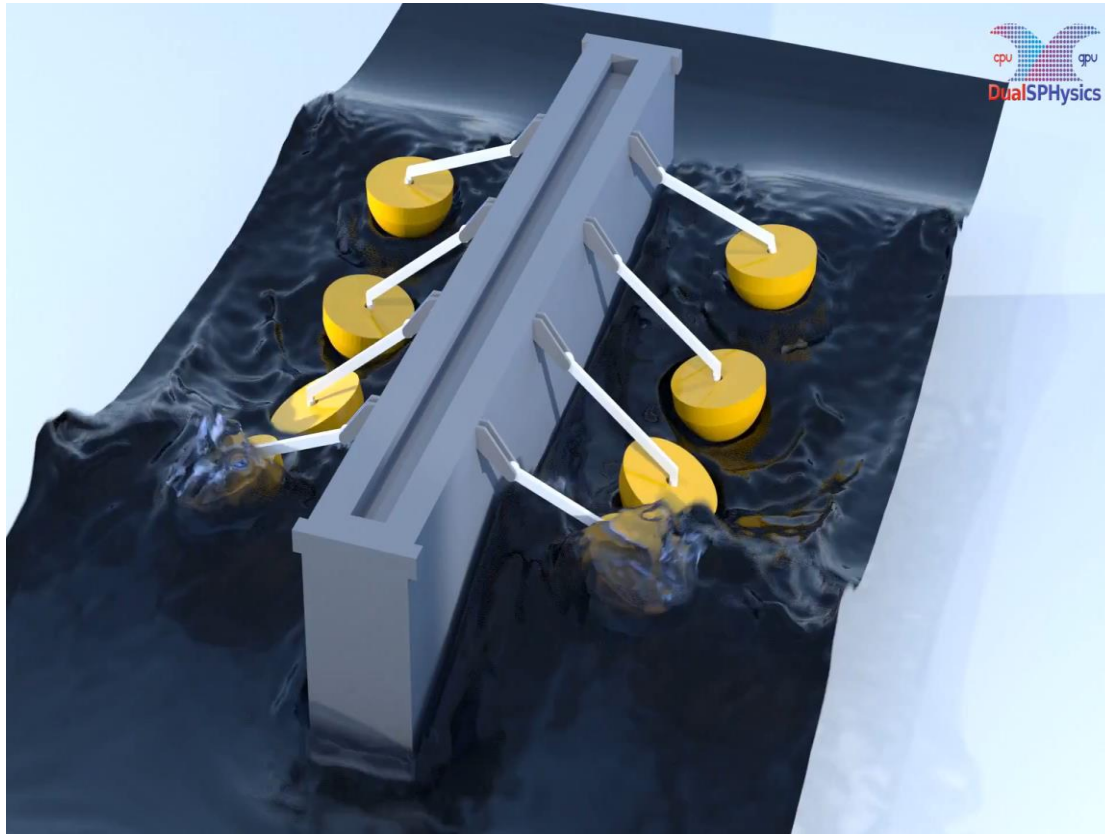


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## Graphical User Interface

# DualSPHysics code



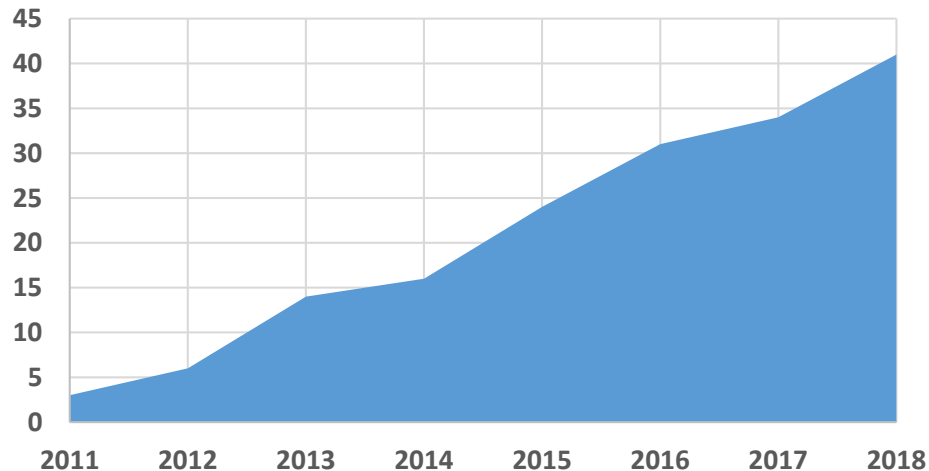
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# DualSPHysics code



<http://dual.sphysics.org/index.php/references/>

DSPH Team Publications 2011-2017



**More than 40 papers** in peer-reviewed SCI journals  
**Cited more than 1055 times (>25 cites/paper)**  
**(SCOPUS 12/06/2018)**

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## PhD by or supervised by members of DualSPHysics Team

2008: A.J.C. Crespo: Application of the Smoothed Particle Hydrodynamics model SPHysics to free-surface hydrodynamics, Universidade de Vigo

2010: Pourya Omidvar: Wave Loading on Bodies in the Free Surface Using Smoothed Particle Hydrodynamics (SPH), University of Manchester.

2010: Renato Vacondio: Shallow Water and Navier-Stokes SPH-like numerical modelling of rapidly varying free-surface flows, Università degli Studi di Parma Facoltà di Ingegneria.

2013: Athanasios Mokos: Multi-phase Modelling of Violent Hydrodynamics Using Smoothed Particle Hydrodynamics (SPH) on Graphics Processing Units (GPUs), University of Manchester.

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2014: Arno Mayrhofer: An Investigation into Wall Boundary Conditions and Three-Dimensional Turbulent Flows using Smoothed Particle Hydrodynamics, University of Manchester.

2014: José Domínguez: DualSPHysics: Towards High Performance Computing using SPH technique, Universidade de Vigo.

2014: Georgios Fourtakas: Modelling multi-phase flows in Nuclear Decommissioning using SPH, University of Manchester.

2015: Anxo Barreiro: Smoothed Particle Hydrodynamics model for civil and coastal engineering applications, Universidade de Vigo.

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2015: Ricardo Canelas: Numerical modeling of fully coupled solid-fluid flows, Universidade de Lisboa, Instituto Superior Técnico.

2016: Angelantonio Tafuni: Smoothed Particle Hydrodynamics: development and application to problems of hydrodynamics, Tandon School of Engineering, New York University.

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# DualSPHysics code



## Practical sessions using DualSPHysics :

1 June 2012: 7th SPHERIC Worskhop, Monash University Prato Centre, Prato, Italy

3 June 2013: 8th SPHERIC Workshop, SINTEF, Trondheim, Norway

2 June 2014: 9th SPHERIC Workshop, Conservatoire National des Arts et Métiers in Paris, France

15 June 2015: 10th SPHERIC Workshop, Parma University, Parma, Italy

12 June 2017: 12th SPHERIC Workshop, Universidade de Vigo, Ourense, Spain

17 October 2017: 1st SPHERIC in Asia. Beijing, China

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13 November 2017: 3rd DualSPHysics Users Workshop, University of Parma, Italy

10 April 2018: SPH 2-day CPD Course, University of Manchester, UK

19 June 2018: Course: “DualSPHysics: Numerical tool in coastal engineering and marine energy”, Centro de Estudios de Técnicas Aplicadas del CEDEX, Madrid, Spain

25 June 2018: 13th SPHERIC Workshop, National University of Ireland, Galway, Ireland

27 September 2018: Short Course on “Computational Fluid Dynamics for Free Surface Flows by Smoothed Particle Hydrodynamics”, University of Florence, Italy

22 October 2018: 4th DualSPHysics Users Workshop, Instituto Superior Tecnico, Lisbon, Portugal

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