

Interactive Software Exhibits for Mathematics Outreach

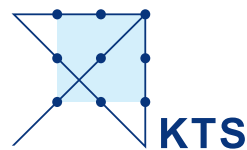
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AIMS-IMAGINARY workshop

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Klaus Tschira Stiftung
gemeinnützige GmbH



Mathematisches
Forschungsinstitut
Oberwolfach

Outline

A brief introduction to IMAGINARY's online programmes with selected examples:

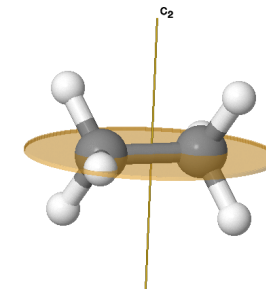
Pure Mathematics:

Does mathematics know a formula for love?



Applied Mathematics (Chemistry)

What is a symmetry group?



Applied Mathematics (Meteorology)

Why would you need mathematics for a volcanic eruption?



What should a mathematics software be able to do in an outreach/communication context?

- motivate
- relate
- explain
- educate

Not all programs have to fulfil all these, but it should be the goal of the designer/programmer to address these points.

imaginary.org

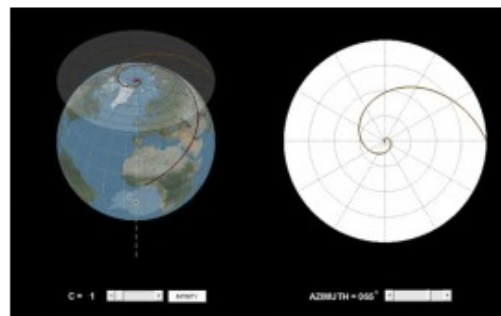
is possible to position the light source so that beautiful symmetric...

DUNE ASH



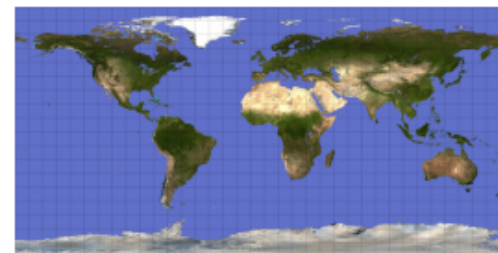
Dune Ash is an interactive simulation of a volcano eruption in Europe. You can place a volcano, add a wind field and explore the ash cloud dispersing in time....

RHUMB LINES AND SPIRALS



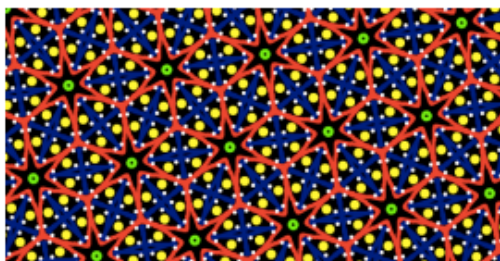
This interactive module illustrates, in a historical context, the rhumb lines on the Earth and the spirals that correspond to a remarkable family of their projections in the plane....

THE SPHERE OF THE EARTH

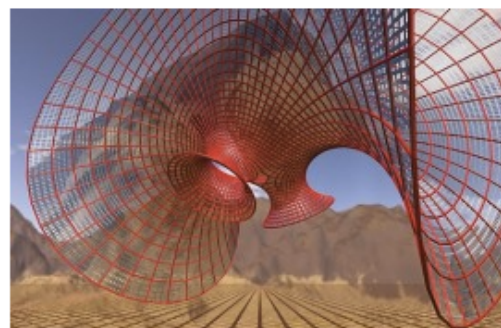


This exhibit explores the science of cartography and the geometry of the sphere. The geometric properties of the sphere and the plane are essentially different, and no map can faithfully represent the Earth without distortion. This module goes through some of this properties, comparing different...

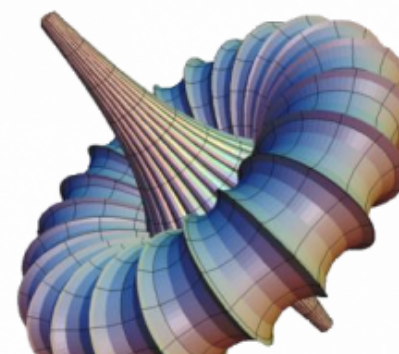
MORENAMENTS



JREALITY EXHIBIT



3D-XPLORMATH



A variety of programs is available on the website, but also a variety of texts, galleries and information on how to create hands on exhibition material.

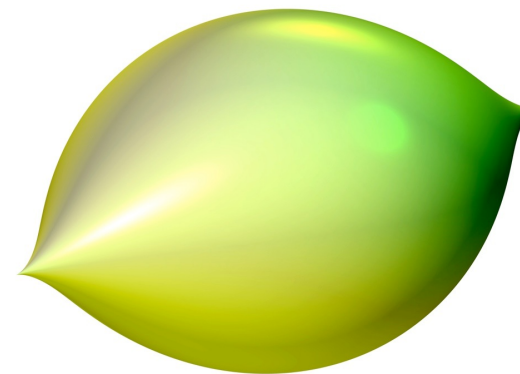
Surfer

What is the solution of this equation?

$y = ax + c$ a straight line of course.

What is the solution of this equation:

$$x^2 + z^2 = y^3(1 - y)^3$$



Zitrus $x^2 + z^2 = y^3(1 - y)^3$

Surfer - A programme to visualise algebraic surfaces

Education: connection between solutions of polynomial equations and surfaces are illustrated interactively

Motivation: appearance of the programme makes it fun to play with and makes it also possible to create individual pieces of art.

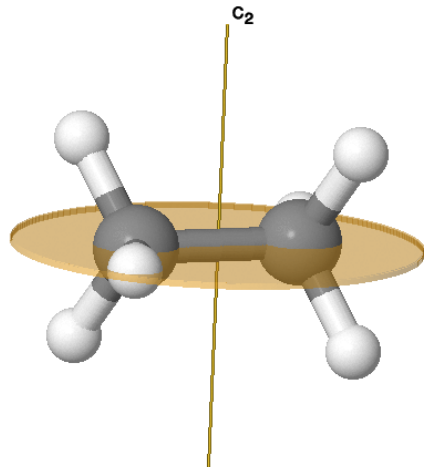
Communication: links to current research in algebraic geometry

Surfer

Go to Program

Cinderella

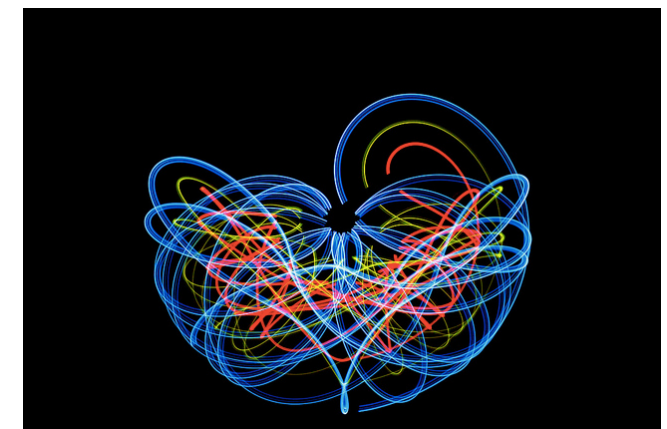
What is a symmetry group and why do I need to know about it?



Symmetry is not only a mathematical concept, but has also a large area of application in e.g. Chemistry

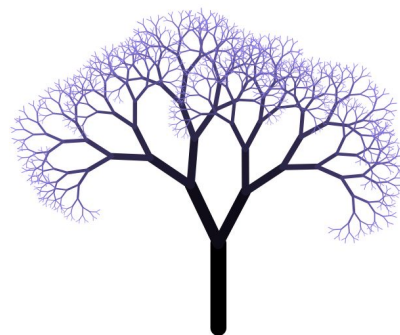
What is a simulation of a mathematical model?

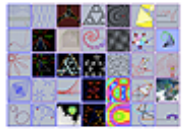
Simulation path of a double pendulum.



What is a fractal?

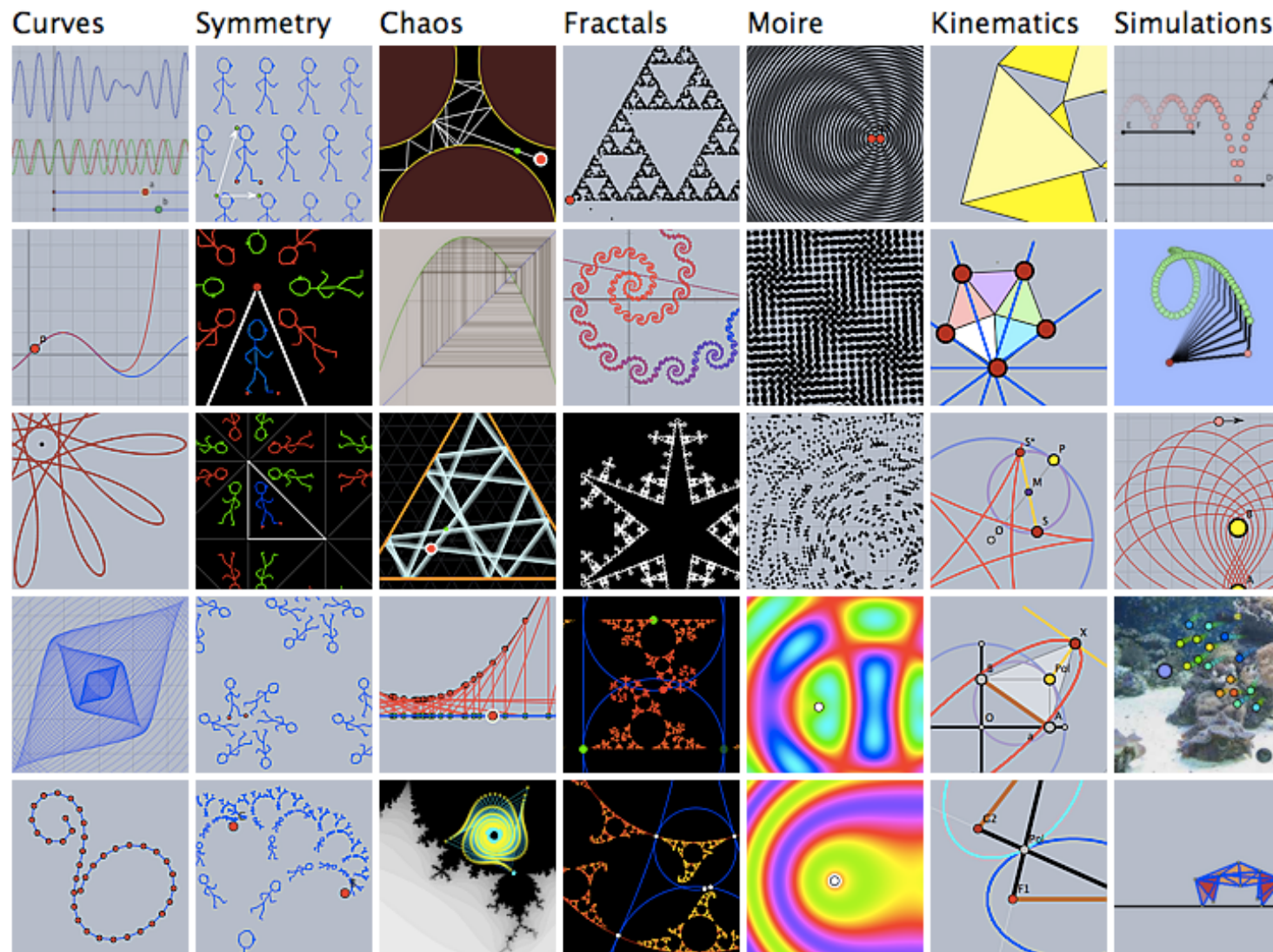
A tree or a fractal?





CINDERELLA

> CATALÀ
> ESPAÑOL
> DEUTSCH



Cinderella is a versatile application explaining many different mathematical concepts

DuneAsh

In April 2010, major parts of the European airspace were closed for over a week, because of a volcanic eruption.



How has mathematics affected this airspace closure?

You are probably interested in how the **volcanic ash** that is erupted into the atmosphere **will move** under **given wind conditions** and in this way predict whether it is still necessary to keep the airspace closed.

This is how it will move:

$$\partial_t c + \nabla \cdot (wc) - \epsilon \Delta c = v$$

Can anyone tell me what this equation means?

DuneAsh

Yes, it is a partial differential equation. How can we explain what this is to a pupil or the general public?

a differential equation tells you how a position (of a particle) varies over time.

The diagram shows the partial differential equation $\partial_t c + \nabla \cdot (wc) - \epsilon \Delta c = v$ enclosed in a blue rectangular box. Arrows point from various parts of the equation to their physical interpretations:

- An arrow from $\partial_t c$ (where ∂_t is circled in red) points to "change over time".
- An arrow from c points to "concentration".
- An arrow from w points to "windfield".
- An arrow from ϵ points to "diffusion coefficient".
- An arrow from Δc points to "change in concentration".
- An arrow from v points to "source term (ash erupting)".

We have defined the terms, but do we know how to solve the equation, or what exactly it means? No, but DuneAsh can do that for us.

DuneAsh

Go to Program

Acknowledgements

Surfer:

Programming: Christian Stussak
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(previous version)

and many more contributions

Cinderella:

Programming: Jürgen
Richter-Gebert, Ulrich
Kortenkamp

DuneAsh:

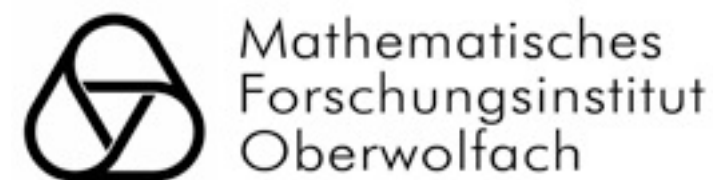
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<http://imaginary.org/about>