

VISH is starting up...

### **Concepts and Vishions** Werner Benger Scientific Visualization group at CCT

## FAQ

### Can VISH visualize my data and make pretty images? – Simple answer: NOT YET 🛞

## Then, what is it good for? It will soon be able to do so, and do it better than anything else ③

• Next slides: how?

## **VISH Status**

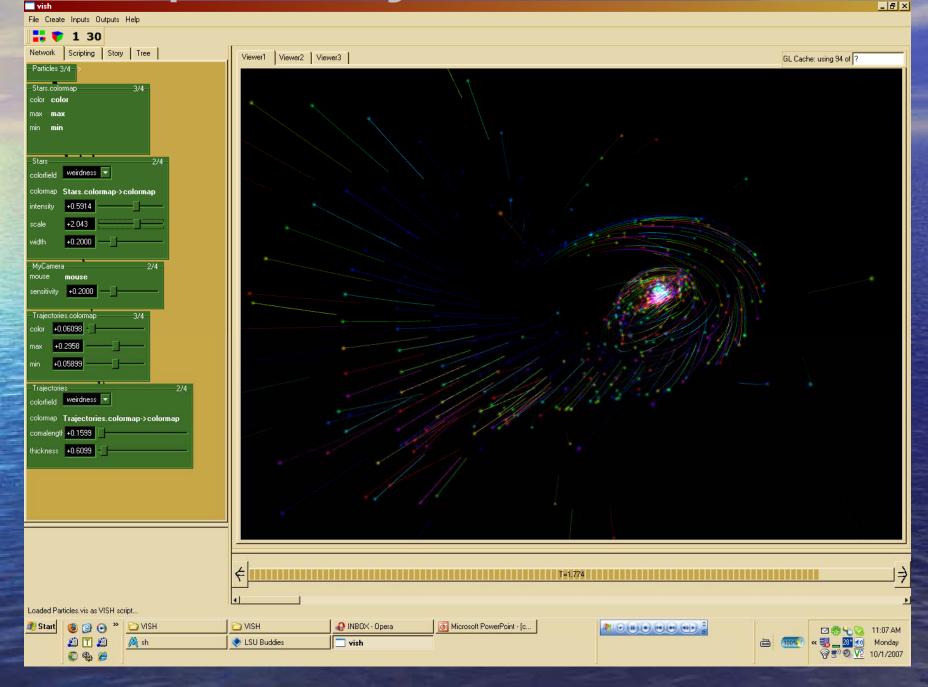
VISH is currently under development
Close to reach end-user productivity level, but not yet fully at this stage
Development is demand-driven
Screenshots!

## **Example: Particle System**

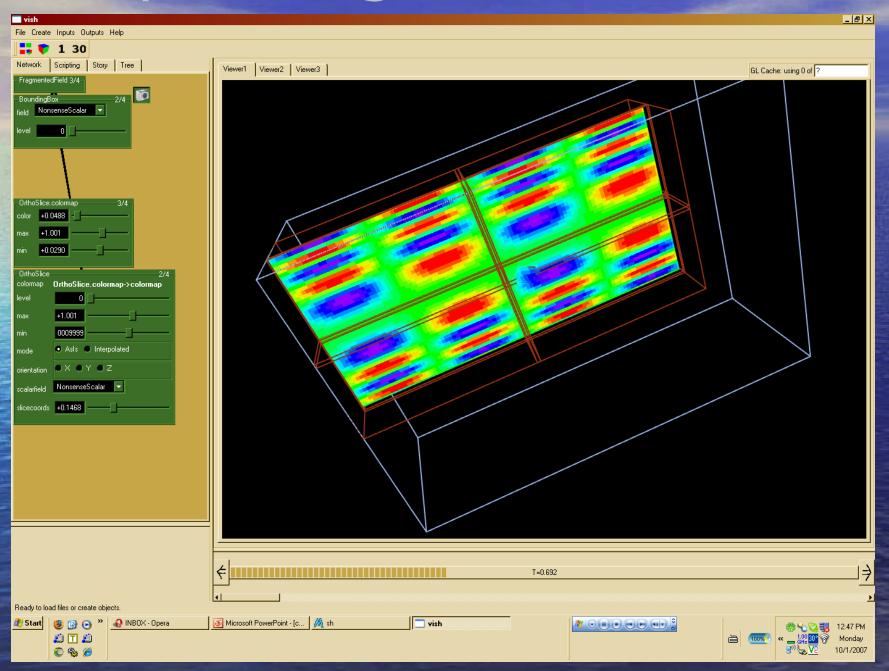
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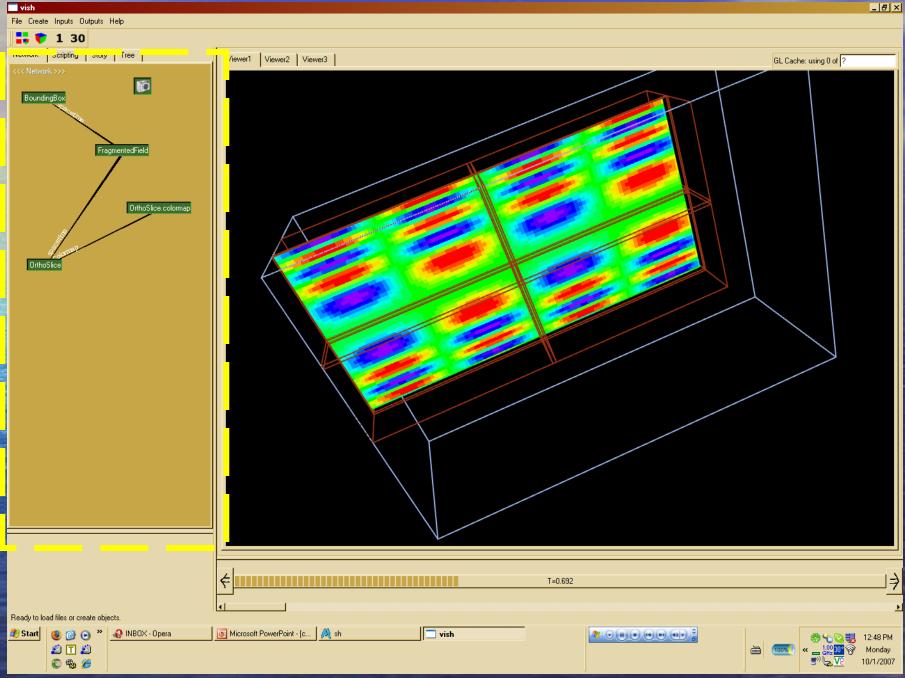
## **Example: Trajectories**



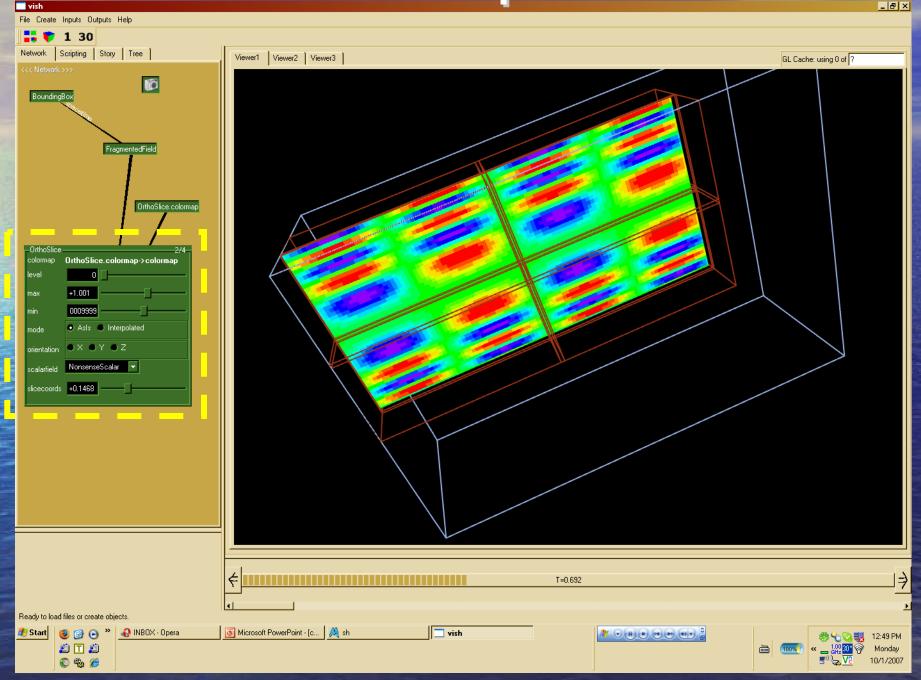
## **Example: Fragmented Orthoslice**



## GUI: Iconized Network

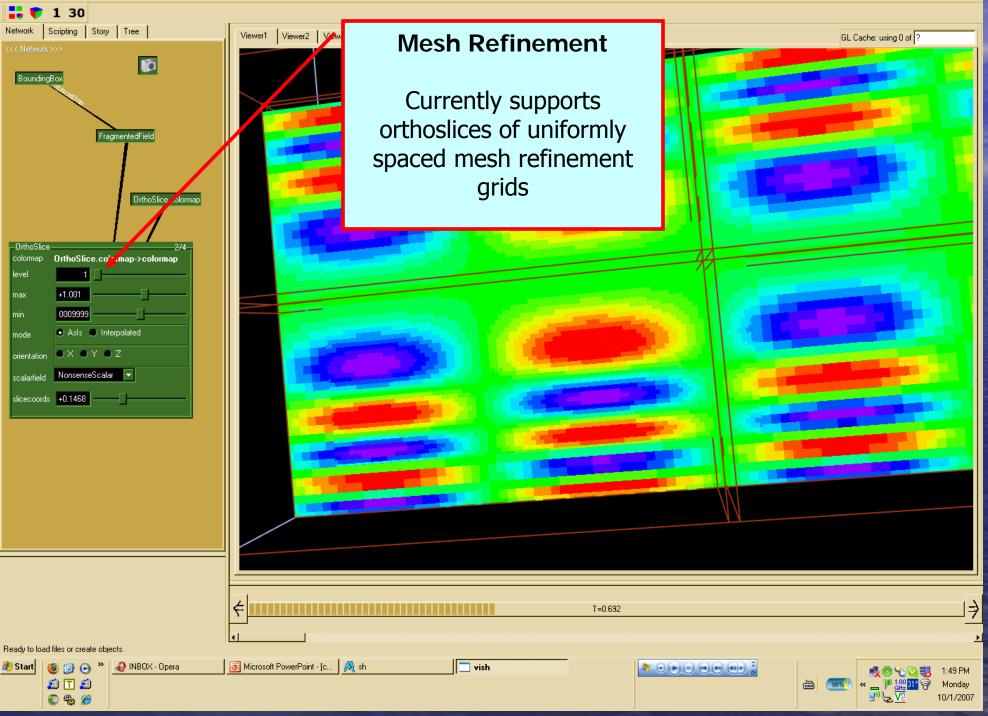


## Parameter GUI Expansion



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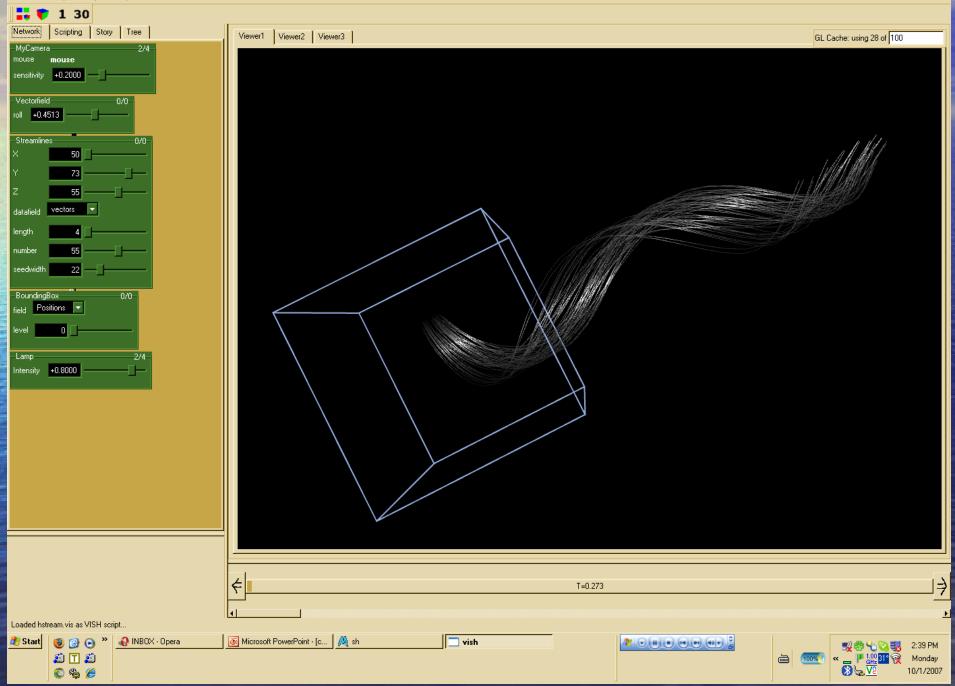


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## Example: Specular Streamlines

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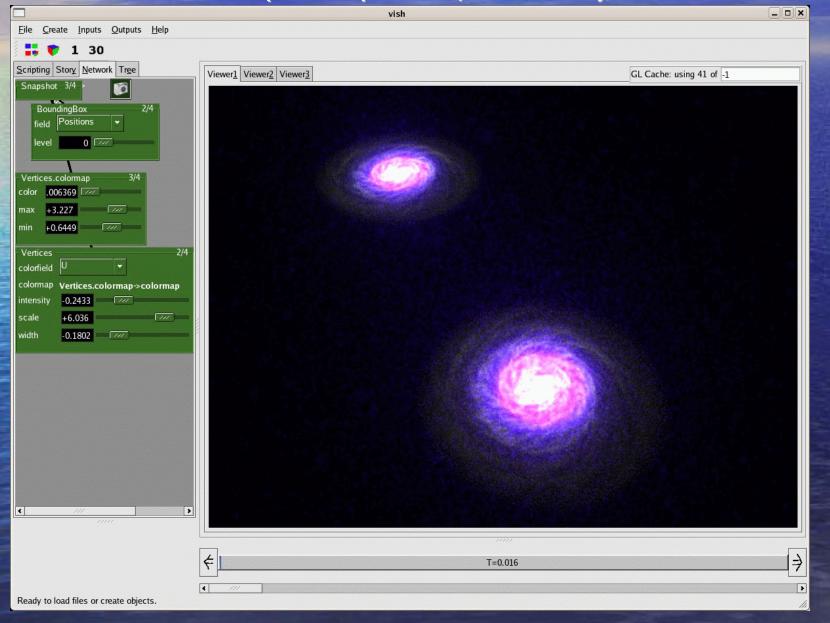
## Example: Vector Arrows

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## SPH Particle Data set

### (2.6mio particles, interactive)



## **VISH Components**

Application

User Interface Event Handling, User Interaction Data Storage Memory Layout

#### VISH Kernel

Abstract Interfaces and Plugin Mechanisms FiberLib2 Data Model for Scientific Data Visualization Algorithm

## **VISH Components**



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VISH

Kernel

User Interface Data Storage

FiberLib2

 Kernel with object management and (runtime) plugin mechanisms User Interface plugins (e.g., QT frontend) Data model (systematic treatment of scientific data via a common approach) - I/O layer as runtime plugins (file formats, streaming) Visualization infrastructure **OpenGL** caching mechanisms

## What stands "VISH" for?

A Visualization Shell • A framework for realizing Visualization Wishes Something else... (free to imagination) Pronouncation (proposal): - Even times: "fish" - Odd times: "wish" - Maritime naming convention

## VISH Kernel: ocean

 Database-like kernel Abstract objects with inputs and outputs – Plugin mechanisms Data and control flow management OpenGL support library - Layered rendering - Multidimensional Cache management

NNM

## VISH GUI: qVISH

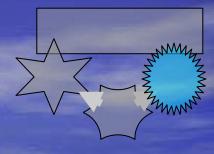
Reference prototype implementation based on QT (both qt3 and qt4 possible) Plugin to the kernel - Consists of several plugins itself, such as Network, scripting, tree, story representation Other GUI's possible: GTK, wxWindows, FLTK, none (batch mode) Interfacing existing applications possible: - E.g. run VISH within Amira, or Scirun, or AVS or ...??

FWWW.

## VISH data model: FiberLib2

- Systematic treatment of a wide category of scientific data, based on the mathematics of fiber bundles
- Common denominator for otherwise diverse grid types
- Plugin to VISH ("fiber-VISH" or "FISH")
- No need to use it, customized data types also possible in VISH (but bypassing the FISH infrastructure then)

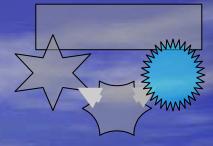
## FiberLib2



Systematic approach for scientific data:
 – Particle systems → unstructured grid → regular grids → uniform grids → block-structured uniform grids → curvilinear multiblock grids ...

 Incremental transition from one such category to next one

Can cover multiple timesteps, grids, fields...



## FiberLib2 I/O features

 I/O layers are plugins (shared libraries) independent of core implementation Distinction among data and metadata - on-demand loading and creation of data - Cache-management Most powerful I/O layer is "F5" -1:1 representation of the FiberLib2 into HDF5

#### Applications

#### Libraries

Local File Remote File Streamed File Grid File

HDF5

### E.g. CGNS HDF5

plication specific

#### Fiber Bundle HDF5 ("F5")

Application oriented,

C Library

#### Other File formats

CGNS F5 I/O

Simple Postprocessing Tools

### CGNS I/O

FiberLib2 plugin

#### Fiber Bundle Data Model

C++ Kernel

#### Amira

**Render Operators** 

#### Grid and Field Operators

qVISH

Interactive Viewer 🗸

Analysis Tools

## C++ Coding

## Background.cpp

#include <ocean/plankton/VCreator.hpp>
#include <ocean/GLvish/VRenderObject.hpp>

using namespace Wizt;

{

#### class <u>DefaultBackground</u> : public VRenderObject

TypedSlot<int> Red, Green, Blue;

override void render(VRenderContext&Context) const
{
GLclampf red=1, green=1, blue=1, alpha=1;
int r=100, g=100, b=100;

Red << Context >> r; Green << Context >> g; Blue << Context >> b;

red = r/100.; green = g/100.; blue = b/100.;

glClearColor( red, green, blue, alpha );

glClear(GL\_COLOR\_BUFFER\_BIT);

#### public:

```
const std::type_info&getType() const
{
     return typeid( <u>DefaultBackground</u> );
}
```

DefaultBackground(const string&name, int p, const RefPtr<VCreationPreferences>&VP)
: VRenderObject(name, BACKGROUND\_OBJECT+p, VP)
, Red (this, "red" , 65, new VCreationPreferences("local") )
, Green(this, "green", 65, new VCreationPreferences("local") )
, Blue (this, "blue" , 53, new VCreationPreferences("local") )

```
};
```

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static VCreator<DefaultBackground> myBackground("Background");

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## FiberLib2 Usage

Hierarchical tree of substructures, five levels:

- 1. Time dependency (parameter space)
- 2. Grid object (computational domain/mesh)
- 3. Topological information (vertices, cells, ...)
- 4. Coordinate representations & relationships
- 5. Fields (scalar, vector, tensor)
- 6. (field fragments)

# Simplest case: Equidistant static scalar field (float data[X][Y][Z])

- Hierarchical tree of substructures, five levels:
  - Time dependency (parameter space)
  - Grid object (computational domain/mesh)
  - Topological information (vertices, cells, …)
  - Coordinate representations & relationships
  - Fields (scalar, vector, tensor)
  - (field fragments)

## Multiple fields on same domain

- Hierarchical tree of substructures, five levels:
  - Time dependency (parameter space)
    - Grid object (computational domain/mesh)
  - Topological information (vertices, cells, …)
  - Coordinate representations & relationships
  - Fields (scalar, vector, tensor)
  - (field fragments)

# Time-dependent fields on same domain

- Hierarchical tree of substructures, five levels:
  - Time dependency (parameter space)
    - Grid object (computational domain/mesh)
  - Topological information (vertices, cells, …)
  - Coordinate representations & relationships
  - Fields (scalar, vector, tensor)
  - (field fragments)

## Multiple blocks (multiprozessor output)

- Hierarchical tree of substructures, five levels:
  - Time dependency (parameter space)
    - Grid object (computational domain/mesh)
  - Topological information (vertices, cells, …)
  - Coordinate representations & relationships
     Fields (scalar, vector, tensor)
  - (field fragments)

# Mesh refinement or unstructured grids

- Hierarchical tree of substructures, five levels:
  - Time dependency (parameter space)
    - Grid object (computational domain/mesh)
  - Topological information (vertices, cells, …)
  - Coordinate representations & relationships
     Fields (scalar, vector, tensor)
     (field fragments)

## Multiblock Curvilinear grids

Hierarchical tree of substructures, five levels:

- Time dependency (parameter space)
  - Grid object (computational domain/mesh)
- Topological information (vertices, cells, ...)
   Coordinate representations & relationships
   Fields (scalar, vector, tensor)
- (field fragments)

## Multiblock grids with refinement

Hierarchical tree of substructures, five levels:

Time dependency (parameter space)

Grid object (computational domain/mesh)
Topological information (vertices, cells, ...)
Coordinate representations & relationships
Fields (scalar, vector, tensor)
(field fragments)

## Availability

• Code development management:

http://vish.origo.ethz.ch/

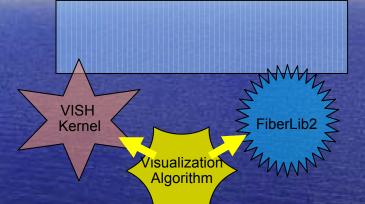
 Available via SVN in source code for registered users

No binary release yet

## **Develop Plans and Priorities**

Visualization Algorithms **Tensorfield visualization** This is research area VISH and FiberLib2: Basic requirements, on-demand implementation and support (e.g. other file formats than F5) • User interface: Reduction to practice (not research)

Need manpower here



## **Isosurface** Implementation

 Do explicit Coding in FISH
 Call external library such as VTK
 Supercede isosurface computation by modern graphics hardware algorithms
 Volume rendering with isolevels
 Gpu-assisted histogram computation