SUMMARY

• VR @ Clermont Campus
  • Institut Pascal, IUT Clermont, ISIMA, LIMOS, SIGMA, SIGMake, IUT Puy-en-Velay, Lab’ du Pensio, LAPSCO, LCS, MSA, IREM, LMBP, OPGC
  • DEMOS

• OPGC into visualisation developped at 3DTeLC
  • Lava flow simulation ‘VolcFlow’
  • Cloud simulation ‘DESCAM3D’
  • DTM and cloud model for VR integration (Flipped classroom)

• Outlook for visualisation developped in 3DTeLC
  • Mathematics for surface modelling
  • 3D stereoscopic visualisation technics
  • Technical workaround with Oculus (Flipped classroom)

• 3D databases (Flipped classroom)
Virtual Reality @ Clermont campus

- SIGMA
  - SIGMake
- LIMOS
- ISIMA «breeding ground» for VR
- IUT Clermont
  - Institut Pascal
    - OPGC
- IUT Puy-en-Velay
- Lab’ du Pensio
- LAPSCO
- Com&Soc
- MSA
- LMBP
- IREM
Institut Pascal

- Institut Pascal: research lab (http://www.institutpascal.uca.fr/index.php/en/)
- Augmented Reality development
- Team: COMSEE/IPSR: core development for 3D Reconstruction from camera images in real-time.

- LABEX: IMobS3
- Partenariat: EXOTIC SYSTEMS
- Contact: Eric Royer (Eric.Royer@uca.fr)
IUT Clermont

• University Institutes of Technology: two-year undergraduate technical diploma
  http://www.uca.fr/formation/nos-formations/catalogue-des-formations/dut-informatique-11270.kjsp

• Computer science: Mobile device study
• Virtual reality flipped classroom (40 hours)
• Various virtual reality hardware!

• Projects: Virtual Reality and Heritage, Training in decision-making and coeliosurgical procedures…

• Contact: Marc Chevaldonné (Marc.Chevaldonne@uca.fr)
ISIMA

• Graduate school of engineering: Three years post graduate, (including MSc, PhD)

• VR Classroom in sept 2018 (Oculus Rift, HTC Vive, PCs with Nvidia 1080, Unity 3D)

• embedded system study: Virtual reality and Robotics

• governance board, 6 seats occupied by companies:

  - Capgemini
  - CRÉDIT AGRICOLE
  - Michelin
  - orange Business Services
  - almerys G2S - Group
  - Fuji Electric

• Contacts: Emmanuel Mesnard (Emmanuel.Mesnard@isima.fr)
VR Partnership, ATOS innovation lab’:

training in handling a crane

Maintenance of a turbopump
ISIMA

• https://www.isima.fr/isima-and-virtual-reality/

• X man:

• RV: https://drive.google.com/file/d/0BxxEC1qmbRA8blgtY1RpUzVJTIE/view

• science feast: https://www.youtube.com/watch?v=sY0w_M9su04

• SAHARA: https://www.youtube.com/watch?v=EaTYGBqF10o

• Contacts: Emmanuel Mesnard (Emmanuel.Mesenard@isima.fr)
LIMOS

- Laboratory of computer science, systems’s modelisation and optimisation: research lab (https://limos.isima.fr/), PhD
- Research group: Geometry, imaGeS, learninG and alGorithms
- Project: https://activmap.limos.fr/Participez/Collecte/

- OpenstreetMap, orthophotos, deep learning: generalization (simplification), STL fabrication

- IREM Collaboration: http://www.irem.univ-bpclermont.fr/ research for mathematics teaching
- Contact: Jean-Marie Favreau (Jean-Marie.Favreau@isima.fr)
SIGMA

- Graduate school of engineering: Three years post graduate + PhD
- Advanced mechanics field
- Master in Automatic-Robotic Image Course, perception system, robotics

- **ACATR**: Training Association for real time and VR
- **VR partenariat**: ARKIMA, ALLEGROBTMIC (leadership in texture)
- **Collaboration**: SIGMA, ISIMA & IUT
- **VR equipment**: Drone DJI Phantom 4, VR headset
- **Project**: Virtual Reality and Heritage...

- **Contact**: Christophe Bascoul ([christophe.bascoul@sigma-clermont.fr](mailto:christophe.bascoul@sigma-clermont.fr))
SIGMAke

- https://sigmake.jimdo.com/
- SIGMAke : Fab’Lab
- Equipments : https://sigmake.jimdo.com/ressources/
- Certification : MIT FabFoundation
- Contacts : sigmake@sigma-clermont.fr
IUT Puy-en-Velay

• University Institutes of Technology: two-year undergraduate technical diploma (https://fr-fr.facebook.com/IUT.ImagerieNumerique/)
• https://ig.iut-clermont.fr/
• Graphics computing
• First year postgraduate in « 3D graphics development » including VR
• Virtual reality classrooms

• Contact: Adélaïde Kissi (adelaïde.kissi@uca.fr)
gravitational lift

• Collaboration: IUT Puy-en-Velay, Laboratory of Magmas and Volcanoes, Création volcans

• Unreal engine, substance for texture (allegorithmic), Blender, Oculus Medium
Lab’ du Pensio

• Lab’ du Pensio : Fab’Lab
• https://fr-fr.facebook.com/labdupensIO/
• Contacts : Rodolphe Crespin (rodolphe.crespin@uca.fr), Adélaïde Kissi (adelaïde.kissi@uca.fr)
LAPSCO

• The Laboratory of Social and Cognitive Psychology: research lab (http://lapsco.uca.fr/)

• CATECH: http://lapsco.uca.fr/catech
• Equipment: Eye tracking, 360° camera, HTC Vive, VR platform soon...

• Collaboration: university hospital center...
• Production: 360° video of Chalet du Puy-de-Dôme
• Contact: Pierre Chausse (Pierre.Chausse@uca.fr)
Communication et sociétés

• Laboratory of communication and societies : research lab (http://communication-societes.uca.fr/)

• Skills : VR applications expertise

• Project : Teaching communication enhanced by VR

• Collaboration : LAPSCO

• Contact : Marion Rollandin (marion.rollandin@uca.fr)
MSA

• Home for science in Auvergne  
  (http://maisons-pour-la-science.org/fr/auvergne)

• VR Course : THE COBOTICS AND FACTORY OF THE FUTURE 4.0
Thanks to FactoLab

FactoLab : Research & development laboratory structured by Labex IMobS3 (Institut Pascal, LAPSCO, LIMOS) and MICHELIN

• Partnership : Michelin, Inoprod et REOVIZ
• Contact : Catherine Lenne (Catherine.Lenne@uca.fr)
IREM

• Research Institute on Mathematics Education
  (http://irem.univ-bpclermont.fr/)

• A teaching sequence in English dedicated to the problem of tessellation

• A booklet providing a brief overview of the main 3D features of GeoGebra

• A booklet proposing many activities to train students in 3D geometry

• Contact : Malika More (Malika.More@uca.fr)
• Laboratory of Mathematics Blaise Pascal: research lab (http://recherche.math.univ-bpclermont.fr/)

• Research groups:
  => PDE (Partial differential equation) and HPC for 3D simulation,
  => Statistics for display on visualization systems,
  => Geometry for mesh simplification…

• Modeling and simulation house (http://math.univ-bpclermont.fr/MMSA/)
  Partnership: PHIMECA, MICHELIN, Maison Innovergne, e-cluster

• Contact: Thierry Dubois (Thierry.Dubois@uca.fr)
OPGC

• observatory globe physics at Clermont-Ferrand:
  Universe science observatory with two research labs: LMV and LaMP (http://opgc.fr/)

• Project: GeolVir3D
• Virtual Geology and Augmented Reality in 3D: from Terrain to Models
• Education concerned: BSc to MSc within EOPGC school
• Partnership for Hardware: KALKIN, 75 inches display PobRun, Sahara (ISIMA,DELL),
  Oculus Rift+Touch…
• Collaboration: ISIMA, LMV, OPGC
• Supported by Learn’In Auvergne (LIA), New Curriculum at the University (NCU),
  OPGC, Cap2025 Challenge 4
• Contact: Philippe Labazuy (P.Labazuy@opgc.fr)
OPGC Data

Data veracity, aggregation, uncertainty, interoperability...
Possible **scale** classification: Atomistic (ex: Microphysics) => Handleable (ex: Mineral, hailstone) => local (ex: Volcano) => mesoscale (cyclone) => global (earth) => astronomic.
OPGC

**NEWS: UNESCO accepted this month!**

Ben is second to candidacy

Ben.VANWYK@uca.fr

**Drone @ OPGC:** 1 big drone insured, 3 pilots!

- Production: 360 video of Chalet du Puy-de-Dôme
- Project: 3DTeLC, today 😊
• OPGC into visualisation developed at 3D TeLC
  • Lava flow simulation ‘VolcFlow’

VolcFlow
simulation of volcanic flows

• Matlab

• Computer porting study for interactive visualisation (Qt/OpenGL) and for VR
• OPGC into visualisation developed at 3DTeLC
  • Lava flow simulation ‘VolcFlow’

• MATLAB => C++
• LMGC90 fluid grain simulation integration

• Main goal : VolcFlow into VR

• Real time VolcFlow simulation into VR ?
Data from resulting analysis file are simpler to integrate.
• 2.5D => 3D ?

  • Collaboration : LMV/OPGC, LMBP, LMGC
• OPGC into visualisation developed at 3DTeLC
  • Cloud simulation ‘DESCAM3D’

Céline Planche (LaMP/OPGC) and Wolfram Wobrock (LaMP/OPGC)

• This visu:
  Voxler + ad-hoc animation

• Computer porting study for interactive visualisation (Qt/OpenGL)

• DESCAM3D:
  Fortran + MPI

• OPGC into visualisation developed at 3DTeLC
  • Cloud simulation ‘DESCAM3D’

• Real 3D simulation with 3D PDE and 15 parameters numerically solved: Fortran + MPI

• Conversion from analysis to NetCDF ‘in development’

• Extract 3D information from NetCDF => cloud Mesh => VR integration

• OPGC/LaMP

With paraview

OPGC into visualisation developed at 3DTeLC
- DTM and cloud model for VR integration (*Flipped classroom*)

- Clouds, Lava (Very specific)
  - Texture or mesh model?
- DSM: DTM + Buildings + Vegetation
- DTM

- Mesh versus textures?
- Automatic versus semi-automatic integration?
- Databases or real-time simulated data?
- Adding building 3D models separately?
- Level Of Detail (LOD)
• OPGC into visualisation developed at 3DTeLC
• DTM and cloud model for VR integration (*Flipped classroom*)

...Clouds/lava...

• Rendering: Mesh versus shader?

• Texture => shader (particule shader...)?

• Format for Geometry and texture: OBJ (Geometry 3D) + MTL (Material Template Library), GLTF

GLTF: (*GL Transmission Format*) is a file format for 3D scenes and models using the JSON standard.
• OPGC into visualisation developed at 3DTeLC
• DTM and cloud model for VR integration (*Flipped classroom*)

... DSM tools...

https://pfalkingham.wordpress.com/2016/09/14/trying-all-the-free-photogrammetry/
• OPGC into visualisation developed at 3DTeLC
  • DTM and cloud model for VR integration (*Flipped classroom*)

... DSM ...

• Photogrametry Process: Densify point cloud =>
  Mesh reconstruction =>
  Mesh Refinement =>
  Mesh Texturing ...

• MicMac:
  • C++ (cross-platform)
  • Command line
  • Last update: juillet 2016

• + CloudCompare (3D point cloud processing software)
OPGC into visualisation developed at 3DTeLC
- DTM and cloud model for VR integration (Flipped classroom)

...DTM...

- DTM creation from topographic map with QGIS (semi automatic, interpolation)
- DEM3D (automatic) **OPGC** program to convert ASC DTM file into STL
  - C++
  - Blender
  - 3DBuilder
    - Print!

**DEMO**

DTM used: "Projet cofinancés par l'Union européenne - fonds européen de développement régional FEDER"
• OPGC into visualisation developed at 3DTeLC
• DTM and cloud model for VR integration *(Flipped classroom)*

« Free », like Google Earth
IGN Data - GéoPortail
• OPGC into visualisation developed at 3DTeLC
• DTM and cloud model for VR integration *(Flipped classroom)*

• Puy de Dôme site (Chaîne des Puys) - raster 0.5m - et du Kilian - raster 0.25m - **LiDARVERNE** - 2011:
  • [http://ids.craig.fr/geocat/srv/fre/catalog.search#/metadata/29bdef03-c163-4be1-8804-f16ee2cca3c9](http://ids.craig.fr/geocat/srv/fre/catalog.search#/metadata/29bdef03-c163-4be1-8804-f16ee2cca3c9)
  • Open License
• Outlook for visualisation developed in 3DTeLC
  • Mathematics for surface modelling
    • 0D: Points => Pixels
    • 1D: Curves: Interpolation, approximation
    • 2D: Surfaces:
    • 2.5D: DTM
    • 3D: Volumes, Points => Voxels, CAO
    • 4D: 3D + Real Time => VR
    • XD: hard to represent...

• Curves and surfaces
  • Curves with control points => movements, path
  • Surfaces: Subdivision surface => LOD
• Domain partitioning:
  • Convex hull => Collision detection
  • Delaunay triangulation => well balanced mesh
• Outlook for visualisation developed in 3DTeLC
• Mathematics for surface modelling
• Outlook for visualisation developed in 3DTeLC
• 3D stereoscopic visualisation technics

• Histograms

• box-whiskers

• PCA

...Data visualisation...

http://opgc.fr/vobs
Outlook for visualisation developed in 3DTeLC

- 3D stereoscopic visualisation technics

Data visualisation...

- Network

Scatter plot (3D)

- Gantt

Treemap

- Heat map: analysing risk, risk diagrams...

Streamgraph

Visualize uncertainties:
• Outlook for visualisation developed in 3DTeLC
  • 3D stereoscopic visualisation techniques

Natural Sciences:

Geography,
Ecology:

...Scientific visualisation...
• Outlook for visualisation developed in 3DTeLC
• 3D stereoscopic visualisation technics

Formal sciences: Mathematics,
Theoretical computer science:

…Scientific visualisation…
Outlook for visualisation developped in 3DTeLC
- 3D stereoscopic visualisation technics

**ParaView**
- C++, Fortran, Python
- VTK
- Client Server architecture
- LOD
- Data parallelism

**Visit**
- C++
- VTK
- Extremely large dataset
- Data parallelism

...General purpose visualisation Tools...
• Outlook for visualisation developed in 3DTeLC
• 3D stereoscopic visualisation technics

• Reproduce a perception of relief from 2 images: stereoscopy definition

• ‘Patent Magic’ stereoscope c1865

...Science Museum...
• Outlook for visualisation developed in 3DTeLC
  • 3D stereoscopic visualisation techniques

• 20 seats
  With Samsung Gear VR

...Science Museum...
• Outlook for visualisation developed in 3DTeLC
  • 3D stereoscopic visualisation technics

• Reproduce a perception of relief from 2 images
  ➢ Anaglyphic,
  ➢ Interlaced (metallized screen, two projectors with polarizing filters),
  ➢ Cross vision or parallel vision

...Stereoscopy...
• Outlook for visualisation developped in 3DTeLC
  • 3D stereoscopic visualisation technics

• auto-stereoscopy : lenticular array

➢ DIMENCO 50” 3D Display => 4000 Euros
➢ Waiting to purchase

• alternating liquid crystal glasses …

...Stereoscopy…
• Outlook for visualisation developed in 3DTeLC
  • 3D stereoscopic visualisation techniques

• OPGC: 3D engine know-how
• C++/Qt/OpenGL
• Rotation, translation, zoom
• Orthographic, perspective and stereoscopic view

• Navigator =>
  • add displacement

DEMO

...Stereoscopy...
• Outlook for visualisation developed in 3DTeLC
• 3D stereoscopic visualisation techniques

...Virtual Terrain Project...

« Open source »  « VR complex but osgoculusviewer ? »

http://vtterrain.org/
• Outlook for visualisation developed in 3DTeLC
• 3D stereoscopic visualisation technics

« Cesium VR: Plugin for web-based to support the Oculus VR headset »
https://cesiumjs.org/
• Outlook for visualisation developed in 3DTeLC
  • 3D stereoscopic visualisation technics

• **Virtual reality reminder**

  => interactive computer-generated experience

  Create a **simulated environment** => visual + auditory

  Good immersion = **high frame rate + high resolution + low latency**

• Augmented reality:
  real-world is "augmented" by computer-generated perceptual information

• Mixed reality:
  mix of reality and virtual reality,
  augmented virtuality...

**sensory experience** (sight, touch, hearing and smell) so it includes
  **psychological** aspects like
  **socio-economic vulnerability** due to
  **natural risks** (in France: avalanche, forest fires, flood, land move, storm,
  overseas: cyclone, volcanic eruption, tsunami).
• Outlook for visualisation developed in 3DTeLC
  • Technical workaround with Oculus *(Flipped classroom)*

• OCULUS drivers and softwares:
  • C++ SDK
  • Unreal engine
  • Unity: ‘easy’ to setup => great
• Outlook for visualisation developed in 3DTeLC
  • Technical workaround with Oculus (*Flipped classroom*)

...C++ 3D engines...

• Irrlicht,
• OpenScenGraph,
• Ogre3D…

• Low level (C++)
  => Research simulation compliant integration (but difficult)
  versus

• High level (Unity)
  => Research simulation approximated integration (but easier)

?
Outlook for visualisation developed in 3DTeLC
- Technical workaround with Oculus (*Flipped classroom*)

... Irrlicht ...

- 3D RT engine
- Multiplate-forme
- ZLIB license
- C++
- OpenGL, DirectX
- Fast XML Parser, Basic Physical Management, Particle Engine

Image formats: psd, jpg, png, tga, bmp, pcx
3D formats: 3D Studio meshes (.3ds), (.b3d), Alias Wavefront Maya (.obj), Cartography shop 4 (.csm), COLLADA (.xml, .dae), Microsoft DirectX (.x) (binary & text), OGRE meshes (.mesh), Fichiers STL 3D (.stl)...


Last release: July 2016

« No scripting »
Outlook for visualisation developed in 3DTeLC
  • Technical workaround with Oculus (Flipped classroom)

... Openscenegraph ...
  Last release: April 2018

• 3D gaming/simulation engine API
• Cross-platform
• LGPL license
• C++
• OpenGL,
• Fields: ... virtual reality

Image formats: .rgb, .gif, .jpg, .png, .tiff, .pic, .bmp, .dds, .tga and quicktime
3D formats: COLLADA, LightWave (.lwo), Wavefront (.obj), OpenFlight (.flt), 3D Studio Max (.3ds), DirectX (.x) ... There are exporters into .osg format available for Blender...
• VR EX: https://github.com/bjornblissing/osgoculusviewer (updated June 2018)
• Outlook for visualisation developed in 3DTeLC
  • Technical workaround with Oculus (*Flipped classroom*)

… OGRE …

Last release : April 2018

• scene-oriented, 3D RT engine API
• Cross-platform
• MIT license
• C++
• OpenGL, DIRECT3D

3D formats : 3D Studio Max, Maya, Blender, LightWave, Milkshape 3D, Sketchup and more

• VR Examples :
  https://github.com/Germanunkol/OgreOculusSample
- Outlook for visualisation developed in 3DTeLC
- Technical workaround with Oculus (*Flipped classroom*)

<table>
<thead>
<tr>
<th></th>
<th>OCULUS RIFT</th>
<th>HTC VIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISPLAY</td>
<td>OLED</td>
<td>OLED</td>
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<tr>
<td>RESOLUTION</td>
<td>2160 x 1200</td>
<td>2160 x 1200</td>
</tr>
<tr>
<td>Refresh Rate</td>
<td>90Hz</td>
<td>90Hz</td>
</tr>
<tr>
<td>Field of view</td>
<td>110 degrees</td>
<td>110 degrees</td>
</tr>
<tr>
<td>Platform</td>
<td>Oculus Home</td>
<td>SteamVR, VivePort</td>
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<tr>
<td>Controller</td>
<td>Oculus Touch, <strong>Xbox One controller</strong></td>
<td>Vive controller, any PC compatible gamepad</td>
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<tr>
<td>Tracking area</td>
<td>8 x 8 feet (three sensors), 1 sensor</td>
<td>15 x 15 feet</td>
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<td>Requirements</td>
<td>NVIDIA GeForce GTX 960 or greater</td>
<td>NVIDIA GeForce GTX 970 or greater</td>
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<tr>
<td>Price</td>
<td>400E</td>
<td>500E</td>
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</tbody>
</table>

- Playstation VR, HTC VIVE, **OCULUS RIFT**...Headsets...
• Outlook for visualisation developed in 3DTeLC
• Technical workaround with Oculus (Flipped classroom)

...3DTeLC solution...
• Outlook for visualisation developed in 3DTeLC
  • Technical workaround with Oculus (*Flipped classroom*)

  …OCULUS RIFT + Unity…

• OCULUS drivers already included Unity engine

• Documentation and examples:
  • https://developer.oculus.com/downloads/unity/

• **How to contribute**? **Tutored projects**? Forge?
• **Data property**? **Software property**? Licence?
• 3D databases (*Flipped classroom*)

• DTM files
  • From hard disk drive
  • From web service

• 3D model / meshes files (STL, OBJ/MTL, GLTF ? COLLADA DAE, FBX…)

• PostgreSQL DBMS + PostGIS
  • implement the standardized datatype *geometry*
    and corresponding functions

• ?
Questions ?