Virtual and Augmented reality in VTK / ParaView

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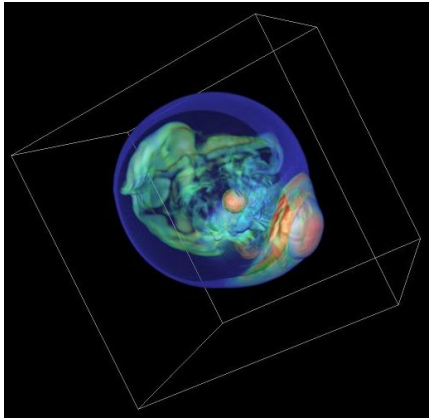
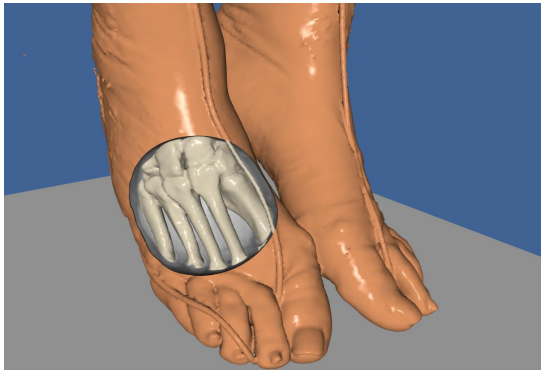
VTK / ParaView

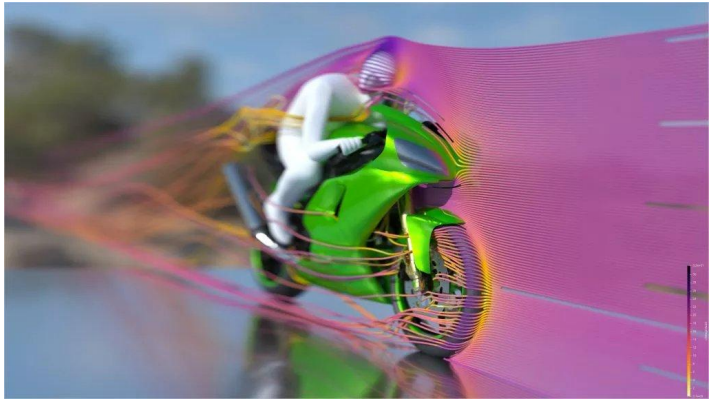
- VTK (Visualization ToolKit) :
  - Currently version 9.0
  - open-source visualization library developed by Kitware
  - A lot of applications / library uses VTK (3D Slicer, ParaView, ITK, TTK ..)
- ParaView :
  - Currently version 5.9.1
  - open-source application built in top of VTK
  - Client / Server architecture, remote rendering
  - Multi-thread, multi-process

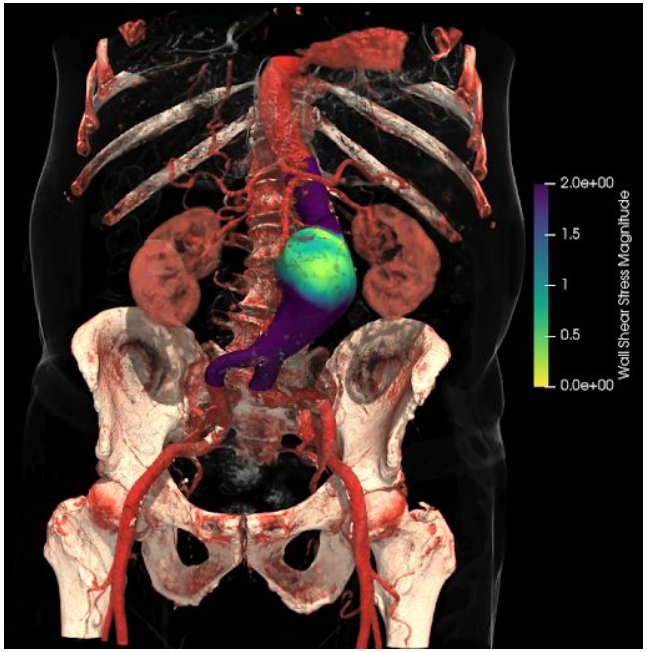
VTK / ParaView



Dataset Courtesy of the Terascale Supernova Initiative (TSI)



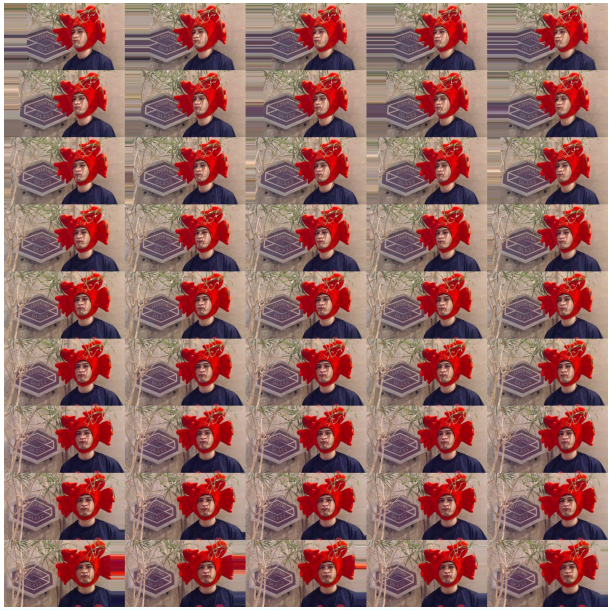




Noeska Smit (University of Bergen), Jelmer Wolterink (UT Twente), and Kakkhee Yeung (Amsterdam UMC

Augmented Reality - Looking Glass

- Light field display => no special glasses nor trackers
- Quilt image format => grid of tiles where each tile is a conventional 2D image of a scene :
  - Bottom-Left : leftmost view of the scene
  - Top-Right : rightmost view of the scene
  - Only horizontal offset for looking glass display



- Looking Glass module in VTK
- Looking Glass plugin in ParaView

Augmented Reality - Looking Glass

Augmented Reality - zSpace

- Developed by the zSpace company
- 120 Hz display
- Crystal Eyes stereo (Quad-buffer GPU)
- Tracking glasses
- Tracked stylus with 3 buttons

Currently only available as a ParaView plugin

Soon in VTK !

Supported by EDF

Augmented Reality - zSpace

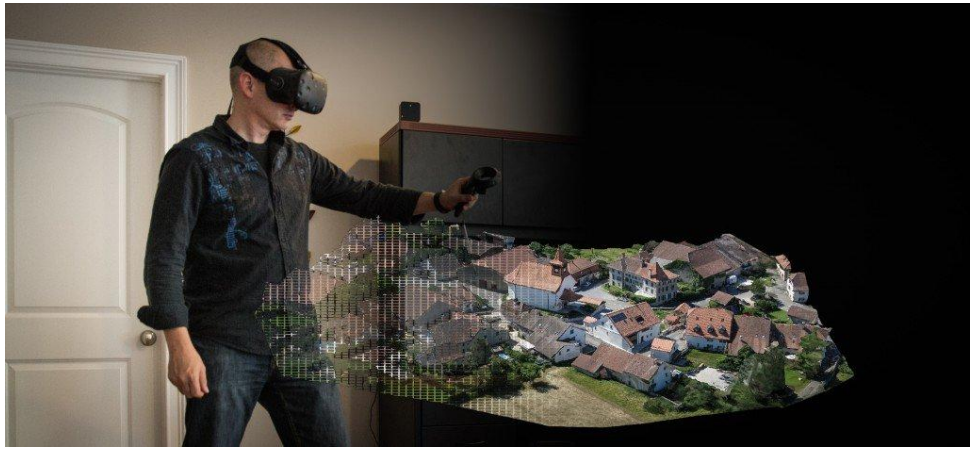
zSpace presentation : https://vimeo.com/511563963

zSpace picking : https://vimeo.com/511564005

zSpace clipping : https://vimeo.com/511563930

Virtual Reality in ParaView / VTK

- Already available using OpenVR API from valve
- Recently new standard API from Khronos : OpenXR
- Both uses SteamVR for generic inputs
- ParaView plugin and VTK module

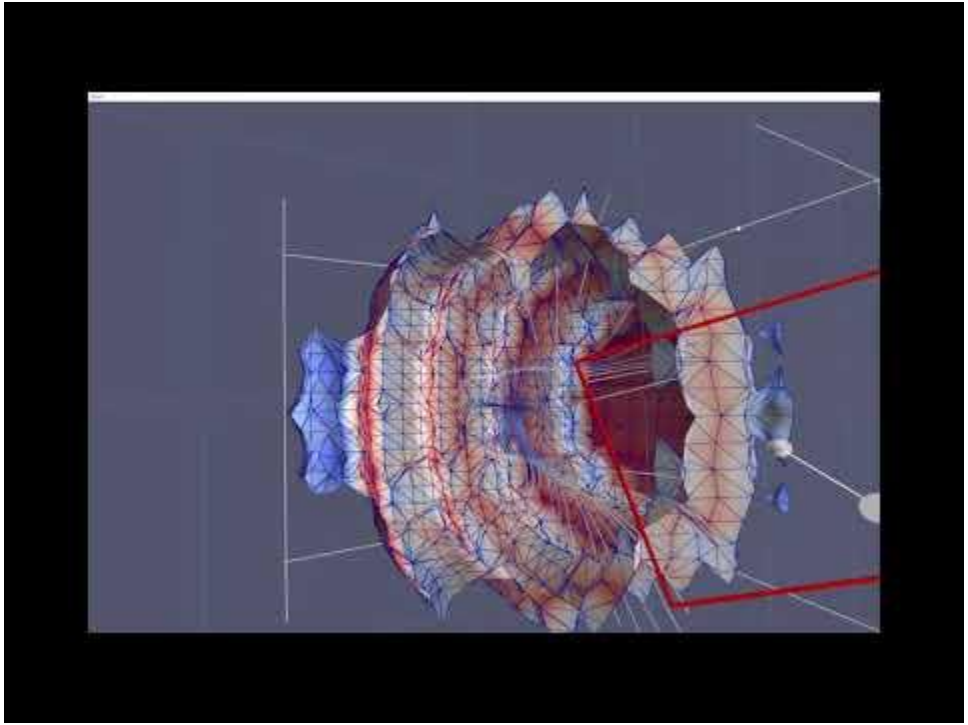


Virtual Reality in VTK

Static Data Exploration: https://vimeo.com/212599095

Helicopter design study: https://vimeo.com/209755936

Virtual Reality in ParaView



Virtual Reality - OpenXR

- New module in VTK to use the new API from Khronos : OpenXR
- Standard, generic, well-documented API
- Actual and future support for almost every VR / AR headsets
- Actions: interaction profile for each headset, ActionSets defined by the app
- Extensions

https://www.khronos.org/registry/OpenXR/specs/1.0/html/xrspec.html

Virtual Reality - VTK inside an HoloLens ?

Challenges :

- HoloLens :
  - ARM architecture with only DirectX backend
  - Wireless headset
- VTK :
  - OpenGL backend only
  - Do not compile on ARM architecture

How can we render VTK inside an HoloLens ?

Virtual Reality - VTK inside an HoloLens ?

- Remote rendering from a computer with VTK to the headset :
  - OpenXR extension XR_MSFT_holographic_remoting
  - Through WiFi
  - Low latency : 60 fps

- VTK rendered with DirectX :
  - OpenGL extension WGL_NV_DX_interop
  - Create a shared buffer DirectX ⇔ OpenGL
  - Render VTK inside this shared buffer
  - Blit shared buffer inside the buffer sent by OpenXR

Questions

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