

The Virtual Imaging Platform: Scientific Applications as a Service and Beyond

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Outline

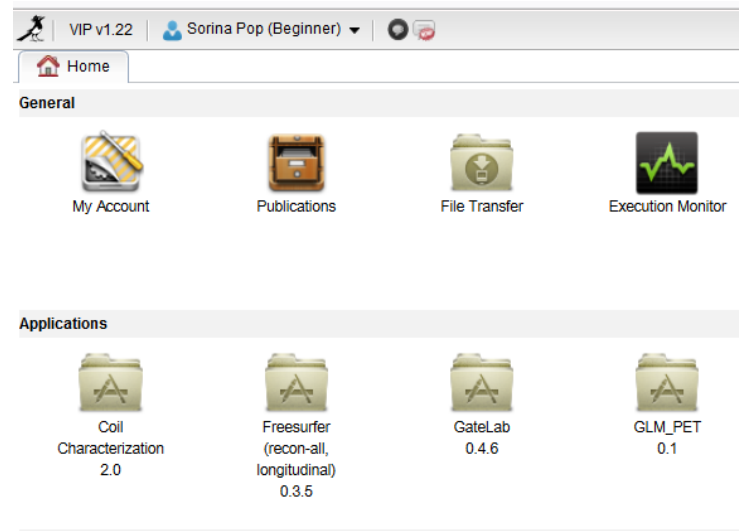
- VIP Presentation
 - What is VIP
 - What's in it for you
 - How VIP works
 - Questions and answers

- Demo
 - Home page and login
 - Launch and monitor an execution

- Questions and answers

The Virtual Imaging Platform

- Web portal for medical imaging applications
- Leverages resources available in the EGI biomed Virtual Organisation (VO)
- Offers an open service to academic researchers worldwide
 - <https://marketplace.eosc-portal.eu/services/virtual-imaging-platform/>
 - More than 1300 registered users
 - More than 20 applications publicly available



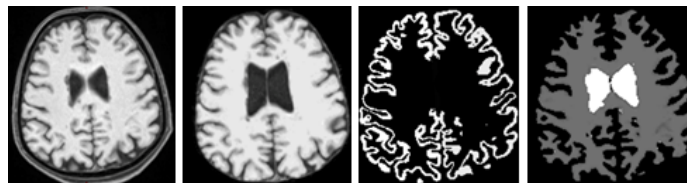
VIP Home Page
<https://vip.creatis.insa-lyon.fr>

What's in it for you

- Scientific applications as a Service
 - Use existing applications on VIP
 - Import your own application and make it available to the community
- Transparent access to computing resources
 - VIP uses EGI biomed resources in a transparent way
- Various use-cases
 - Scientific challenges
 - Web portal and API
- Open and reproducible science
 - Zenodo, DOIs, Containers, Boutiques, ReproVIP

Applications available in VIP

- Internationally used and renowned
 - **GATE** (<http://www.opengatecollaboration.org>): numerical simulations in medical imaging and radiotherapy (based on the Geant4 toolkit)
 - **Freesurfer** (<https://surfer.nmr.mgh.harvard.edu>): open source neuroimaging toolkit for processing, analyzing, and visualizing human brain MR images

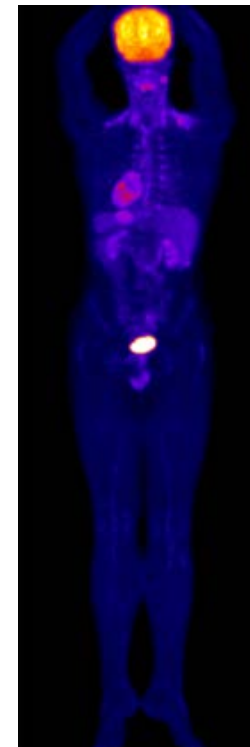


Example of white/grey matter brain segmentation with [Freesurfer](https://surfer.nmr.mgh.harvard.edu) on VIP
Credits : Berardino Barile and Dominique Sappey-Mariniere, Creatis

- “Home-made”

- **MRI Coil Characterization**
RF coils comparison on MRI systems

https://www.creatis.insa-lyon.fr/~mahieu/Documentation_MRlcharacterization.pdf



3D whole-body F18-FDG PET scan simulated with GATE (4,000 CPU hours). Credits: IMNC-IN2P3. 5

Importing new applications

- Integrate a new application in VIP in 3 main steps

- Build a Docker or Singularity image containing the application
- Create a **Boutiques** descriptor of the application (rich and flexible JSON language)
- Send them to the VIP team

- Boutiques

- Automatically publish, integrate and execute applications across computational platforms
- <https://github.com/boutiques>

Findable

1. Globally persistent records
2. Described with rich metadata
3. Searchable

We leverage **Zenodo [2]** to create DOIs for Boutiques descriptors which can be accessed via the Zenodo API.

Interoperable

1. Formalized and shared metadata standard
2. Metadata standards adopted are FAIR
3. Linking between objects where appropriate

CARMIN [3] and **Boutiques [4]** standards are used to describe and launch tools, either locally or through a RESTful API.

Accessible

1. Easily retrievable
2. Universal access
3. Persistent metadata beyond data lifetime

The retrievable tool descriptions contain **immutable** human- and machine-readable instructions for testing and launching each tool.

Re-Usable

1. Multiple accurate and relevant attributes
2. Clearly licensed
3. Meets minimum domain standards

Docker [5] and **Singularity [6]** virtualization enable re-runability across platforms and enclosed testing. Simulation and querying allow runtime evaluation.

FAIR tools. Credits: Gregory Kiar and Tristan Glatard

Transparent access to resources: the Biomed community

- Life Sciences sector with three main thematic groups

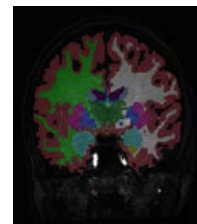
- Medical image analysis
- Bioinformatics
- Drug discovery

- EGI's biomed VO

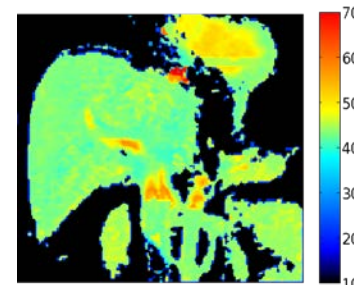
- Operating since 2004
- Approx 15 supporting sites
- Technical teams on shift for monitoring

- Open access

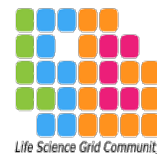
- For non-commercial users
- For life-science applications
- Acknowledgments



Brain tissue
segmentation
with Freesurfer



Hepatic perfusion index (%)
Credits: B. Leporq, O. Beuf

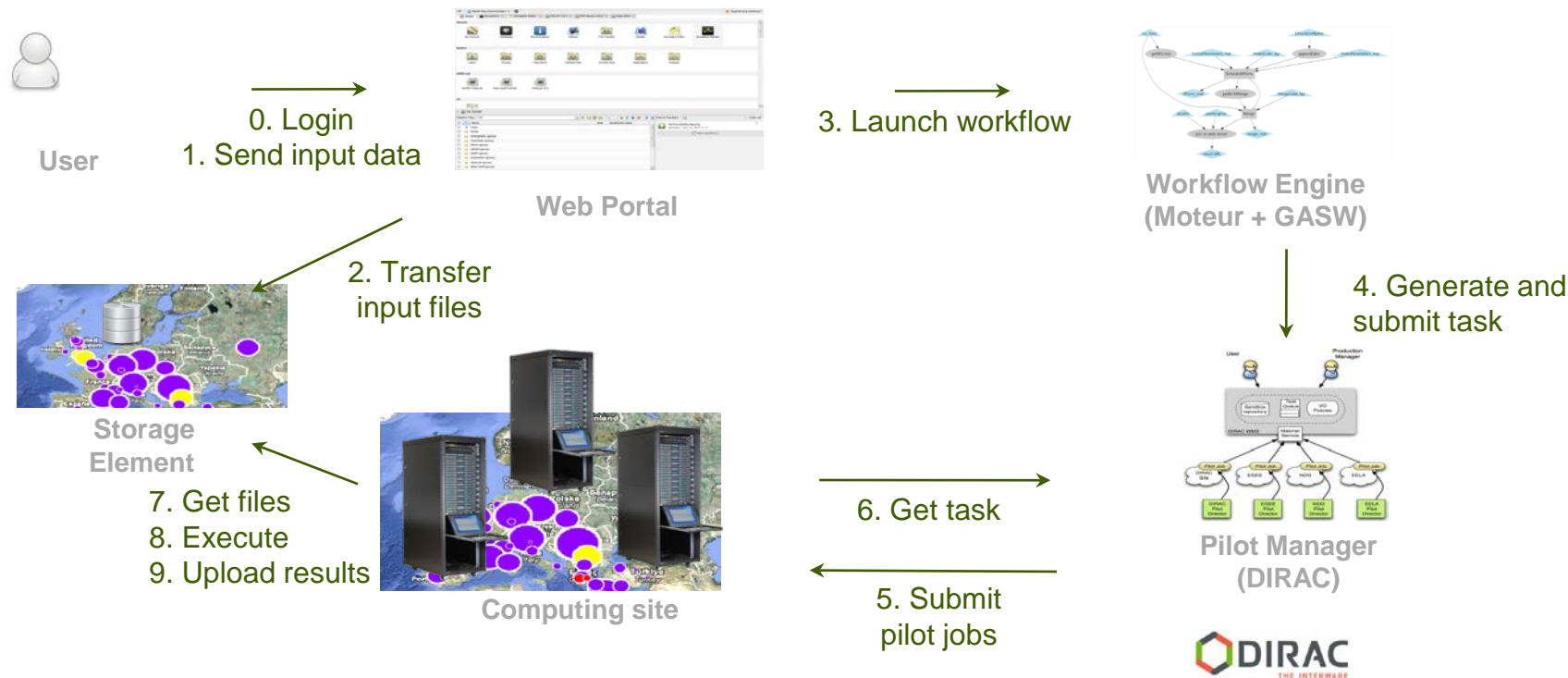


Life Science Grid Community

<http://lsgc.org>



Transparent access to resources: how VIP works

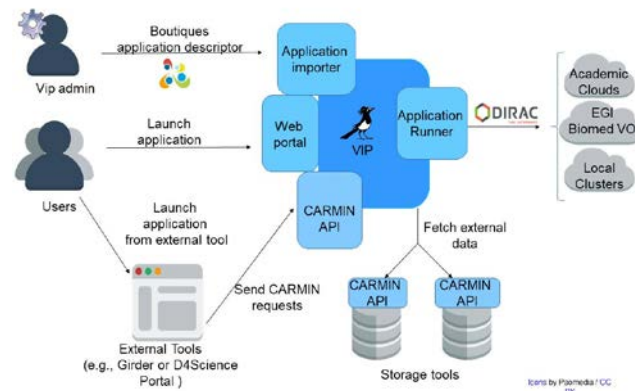
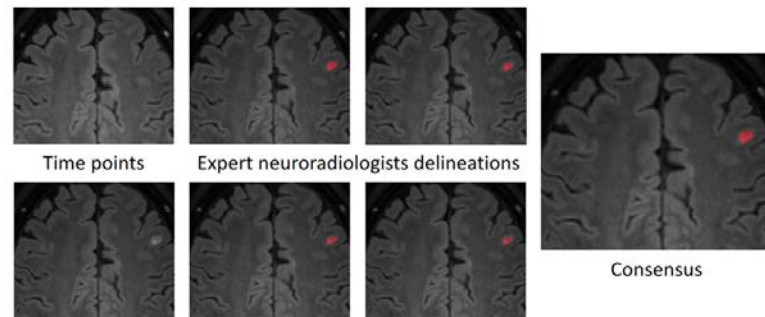


Use-case example: the MSSEG2 challenge

- Multiple Sclerosis (MS) new lesions detection and segmentation
 - <https://portal.fli-iam.irisa.fr/msseg-2/challenge-day>
- 31 pipelines integrated using Docker images and Boutiques descriptors
- Challengers tested and validated the pipeline execution on training images
 - Simple and user-friendly access through the VIP Portal
- VIP team executed pipelines over the 60 patients of the testing set
 - Automation using of the CARMIN API
- Use of Dirac and EGI Cloud resources
 - The DIRAC EGI Workload Manager Service
 - EGI Cloud resources within the Biomed VO (IN2P3 IRES, CESNET, SAVBA).
 - A few local (Creatis) VMs



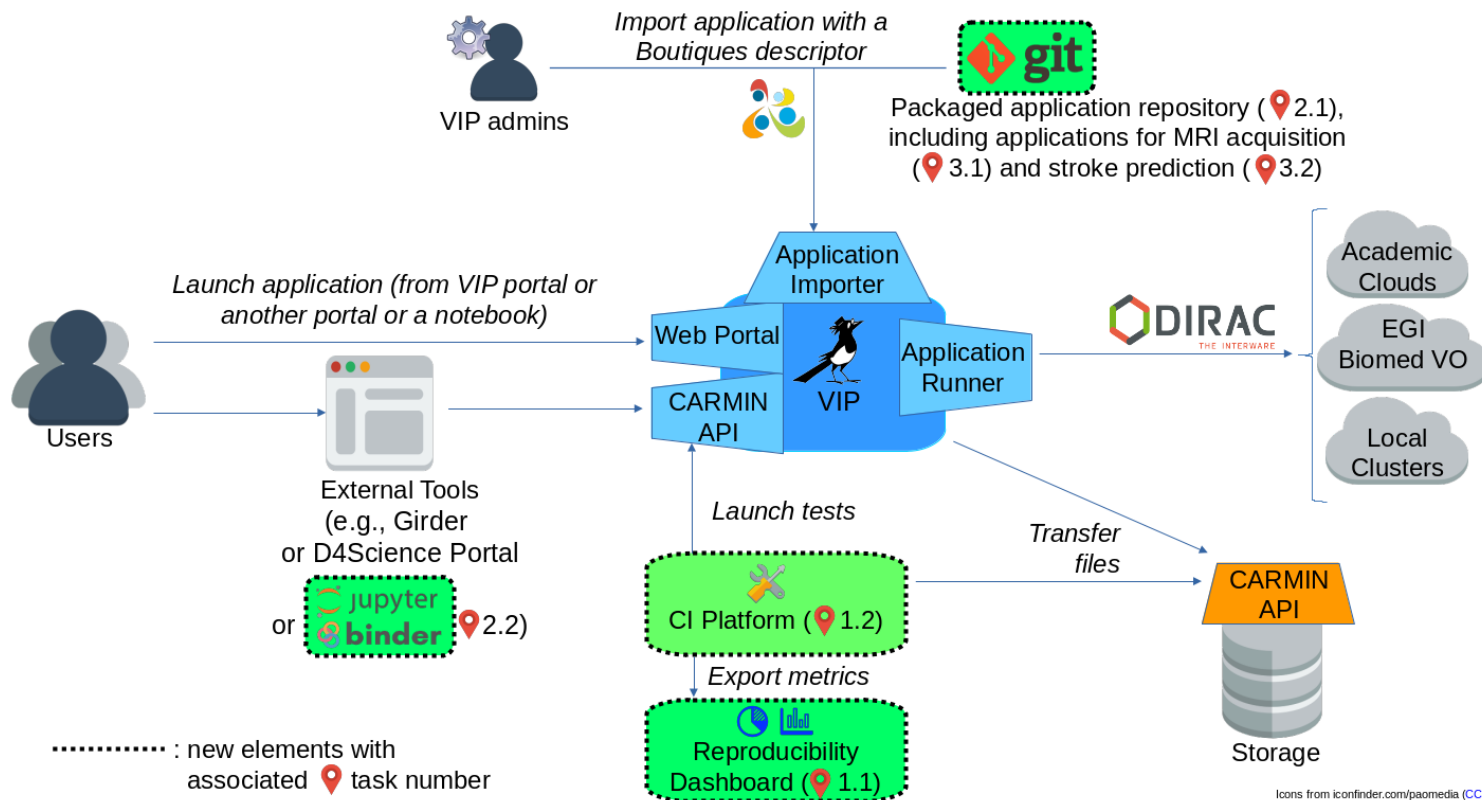
An example dataset



Open and Reproducible Science

- Reproducibility crisis
 - <https://www.biorxiv.org/content/10.1101/843193v1> – the analysis of a single functional neuroimaging dataset by 70 independent analysis teams revealed substantial variability in reported binary results
- ReproVIP (ANR-21-CE45-0024-01)
 - Evaluate and improve the reproducibility of scientific results
 - Same result when the code is executed with the same set of inputs
 - Provide an integrated, end to end solution, allowing to launch reproducible executions in a transparent manner
 - Evaluate the proposed methods and tools on two studies
 - Optimization of the MRI acquisition protocol
 - Optimization of a processing pipeline for stroke prediction

ReproVIP (ANR-21-CE45-0024-01)



VIP Organization

■ VIP team

- Manager: Sorina Pop, CNRS Creatis Engineer
- Permanent contributors: Axel Bonnet (CNRS), Sorina Pop (CNRS), Frédéric Cervenansky (University of Lyon)
- Current project related contributors: Alexandre Cornier (EGI ACE), Sandesh Patil (FLI IAM)

■ VIP source code

- <https://github.com/virtual-imaging-platform>
- 2 VIP releases per year on average
- Multiple repositories for dependencies

■ Collaborations and acknowledgements

- EGI ACE
- FLI IAM (France Life Imaging, Image Analysis and Management node)
- Dirac
- France Grilles
- Tristan Glatard, Associated Professor at Concordia University, Montreal

Thank you for your attention !

Let's go to the demos

1. Home page and login (Alexandre)
2. Launch and monitor an execution (Axel)