ENHANCING REPRODUCIBILITY OF SCIENTIFIC RESULTS IN MEDICAL IMAGING

GAËL VILAS, AXEL BENNET, FRÉDÉRIC CERVENANSKY, CLAIRE MOUTON, TRISTAN GLATARD, EMANUEL MEDERNACH, JÉRÔME PANSANEL, SORINA CAMARASU-POP

FREE & OPEN PLATFORM FOR SIMULATION / PROCESSING OF MEDICAL IMAGES

1400+ registered users
20+ applications available as a service
Web portal: https://vip.creatis.insa-lyon.fr/
Uses EGI resources to provide users with transparent access to high-throughput computing, through the DIRAC framework [1].

RESEARCH ISSUE

Medical Imaging Research (MIR) is facing a reproducibility crisis.

Most MIR applications are unable to produce the same results twice, when applied the same sets of inputs.

Sources of variability can be identified in distinct layers of data processing: (i) the research methodology [2], (ii) the analysis software [3] and (iii) the execution environment [4].

Environment-related variability (iii) is poorly acknowledged by the MIR community and may cause variabilities in scientific results based on distributed computing.

The ReproVIP project is funded by the French National Research Agency (grant N°ANR-18-CE45-0024-01), to address reproducibility issues at each layer of processing.

LIBRARY

The project is structured around three complementary goals:

A. Evaluate the uncertainty of an application’s digital outcomes.
   - Define metrics & criteria to validate a “reproducible” scientific result;
   - Design a reproducibility test protocol to be run after each app execution.

B. Enhance the numerical reproducibility of VIP outcomes using software solutions for open science.
   - For the Research Methodology layer (i), provide EGI-based Jupyter Notebooks on the Web portal (able to use the DIRAC framework);
   - For the Execution Environment layer (iii), run MIR applications on Guix: a GNU-based Linux distribution for advanced package management.

C. Apply reproducibility metrics & know-how on two MIR issues.
   - Metabolite quantification in magnetic resonance spectroscopy;
   - Automatic tumor segmentation in the lower brain regions.

EARLY PROSPECTS

By leveraging cross-environment computing resources from the EGI e-infrastructure, VIP will provide a virtual playground to experiment variability in a pipeline’s results at the environment level (iii).

In the meantime, inter-OS variability can be efficiently simulated by introducing random perturbations in a pipeline’s mathematical operations [5]. This can be done by using a fuzzy version of the GNU mathematical library: Fuzzy-LibMath (compiled with Verificarlo API).

Variability can be assessed across empirical or simulated outcomes.

LITERATURE