

CreaTools¹: applications and development framework for medical image-processing software

E.E. Dávila Serrano*, L. Guigues*, J.-P. Roux*, F. Cervenansky*, S. Camarasu-Pop*,
L. Flórez Valencia[†], M. Hernández Hoyos[‡] and M. Orkisz*

*Université de Lyon, CREATIS; CNRS UMR5220; Inserm U1044; INSA-Lyon; Université Lyon 1, France

‡ Grupo Imagine, Grupo Ingeniería Biomédica, Universidad de los Andes, Bogota, Colombia

† Grupo Takina, Pontificia Universidad Javeriana, Bogota, Colombia

Initiated at CREATIS lab, CreaTools is a collaborative project with los Andes and Javeriana universities from Colombia. It offers stand-alone applications for end users and a complete open-source platform to rapidly develop/prototype medical image processing workflows with sophisticated visualization and user interactions. It builds on top of BBTK (black-box toolkit), a flexible cross-platform framework (Linux, Windows and MacOS) developed in C++, which guarantees an easy connection of heterogeneous C++ modules and provides the user with libraries of high-level components to construct graphical interfaces including input/output (file management), display, interaction, data processing, etc. Currently, these components (black boxes) are mainly based on the widely used open-source third-party libraries: VTK, ITK, wxWidgets and Qt.

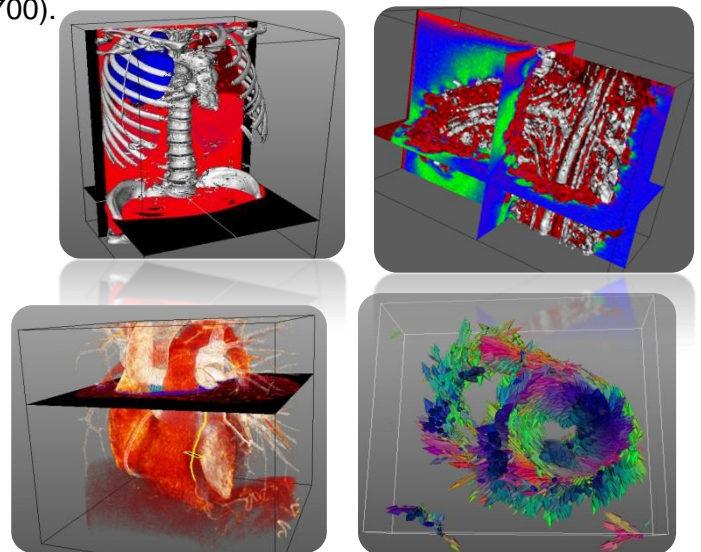
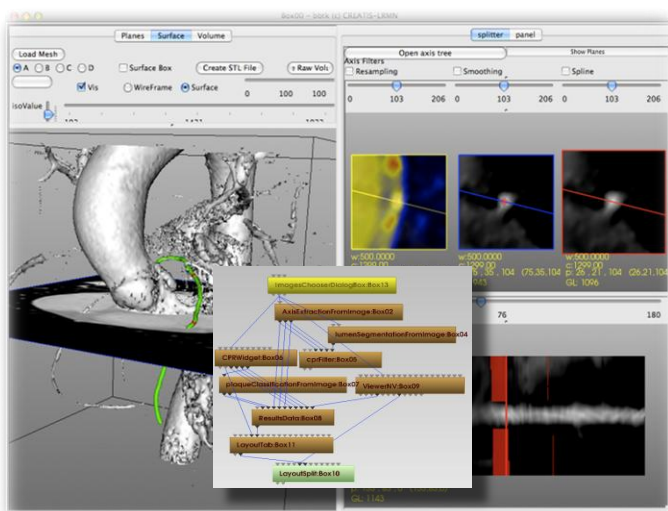
End-users have access to various: 1) mini-tools such as interactive rigid alignment of 2D and 3D images, image cropping, resampling, etc., and 2) full applications such as an advanced interactive 3D viewer including volume rendering and surface rendering with multiple iso-values, as well as an interactive contour tracer in N-dimensional images, calculating a number of statistics within the regions of interest and on their contours.

Developers can use the existing black boxes and/or create new ones, and assemble them into pipelines, in order to construct either stand-alone applications or new complex black boxes (meta-widgets), reusable in other applications. More than 300 black boxes are currently available. Pipeline editing and testing are made easy by a user-friendly graphical editor providing several forms of on-line help. Another very useful utility is creaNewProject that generates the whole structure of a new C++ project, including the necessary third-party libraries and access to BBTK packages. This structure is based on CMake and allows the user to generate projects for the target platforms. Tools necessary to wrap C++ classes into new black boxes are also available.

The CreaTools are used in several projects, e.g. as the software integration platform in a European STREP Thrombus². Other research projects, where the CreaTools have been or are being successfully used, include cardio-vascular studies, the analysis of maxillofacial bones, the segmentation of corals and the quantification of cerebral perfusion, visceral adipose tissue, pulmonary ventilation, etc. Publications related to scientific projects using the CreaTools are listed on the PLUME-FEATHER project page³.

Ongoing developments follow three main axes: 1) interoperability – to guarantee the connection between BBTK and Slicer3D/CTK, and include Matlab in the workflows, 2) distributed computing – to provide the image processing workflows with a direct access to various computing resources such as clusters and grids, 3) virtual reality – to facilitate the interaction with 3D images, by use of stereovision and remote control devices.

The CreaTools can be used, modified and redistributed under the terms of the French license CeCILL abiding the distribution rules of free software. They are protected by the French Agency for the Protection of Programs (IDDN.FR.001.250014.000.S.P.2010.000.20700).



Left: GUI used to study coronary arteries (segmentation and lesion detection) with the corresponding BBTK pipeline superimposed. Right: examples of display from various projects successfully using the CreaTools.

¹ http://www.creatis.insa-lyon.fr/site/en/CreaTools_home partly funded by ECOS Nord C11S01 and Colciencias 1204-519-28996 grants

² <http://www.thrombus-vph.eu/> see also the page of the European NoE VPH <http://toolkit.vph-noe.eu/home/tools/imaging/creatools.html>

³ <https://www.projet-plume.org/en/relief/creatools>