

A Common Software Platform for VPH Biomedical Imaging and Modelling

Rationale

The developing teams of some of the best open source biomedical imaging and modelling software in the world agreed to join forces in the development of a standard that has been called the “Common Tool Kit” (CTK, <http://www.commonstk.org>). The goals of the CTK are to:

- Provide a unified set of basic features for use in biomedical imaging
- Facilitate the exchange and combination of code and data
- Document, integrate, and adapt successful solutions
- Avoid duplication of code and data
- Continuously extend to new tasks within the scope of the toolkit (biomedical imaging) without burdening existing tasks

The idea is to join forces to write once for all those components that are common to most biomedical software tools, so that each group can focus on the research and development of what is truly innovative, and stops re-inventing the wheel. It is also a strategy to reach the critical mass of manpower and of knowledge that is necessary to tackle so very big problems in imaging and modelling. With its orientation to biomedical modelling, CTK is likely to become a key component in the development of the VPH. In this sense the support of some of the most difficult components by a EU-funded consortium would ensure that CTK will have from the very beginning solid roots in Europe, and that its development will be properly aligned to the needs of the VPH community.

The VPH NoE analysed the needs of the VPH community for the development of a VPH Toolkit and clear missing tools were identified. As the NoE cannot undertake such a joint platform development covering all the needs of the community, the aim of this project is to implement a solution focussed on biomedical imaging and modelling. Within the wide spectrum of the VPH community, the idea is to focus on data and models interacting with images, with scales that range from confocal microscopy to full body imaging.

This would enable sharing and joint development of image processing tools, models and simulators, through a collaborative environment supporting this highly multidisciplinary field. Moreover, this would offer a unique opportunity for further work on evaluation and assessment of VPH projects.

Structure

The CTK meeting in Oxford produced a strong request for an EC proposal to support the development of an implementation of the CTK standard. The most interesting target for such proposal is the development of a framework that can provide a common biomedical data / visualisation / processing representation as a foundation of stronger integration between tools and libraries, and a flexible solution that does not stifle innovation. The proposed structure is the following:

- WP1: Management – Suggested leader: ERCIM. Suggested scientific coordination: INRIA
- WP2: CTK-Compliant Kernel – Suggested leader: INRIA. Suggested contributors: B3C, DKFZ, ICCAS, INRIA, OFFIS, UOXF, UPF
- WP3: Data Module - Suggested leader: UOXF. Suggested contributors: ICCAS, OFFIS, UOXF, B3C
- WP4: Visualisation Module - B3C. Suggested contributors: B3C, DKFZ, UPF
- WP5: Processing Module – UPF. Suggested contributors: DKFZ, INRIA, UPF

- WP6: Biomedical Standards Compliance - OFFIS & ICCAS. Suggested contributors: DKFZ, ICCAS, OFFIS
- WP7: Demonstrators and Dissemination – DKFZ. Suggested contributors: B3C, DKFZ, INRIA, UOXF, UPF

Briefly, WP1 is the global administrative management + scientific lead. WP2 is the development of an extensible kernel able to make existing libraries interoperating. WP3-4-5 is integration of existing technology as modules into the toolkit. There may be some new developments in these WPs, but they should stay minor with respect to the integration of what is available already. WP6 is mostly PACS and DICOM compliance. WP7 takes the form of demonstrators, gluing existing technologies into an application with its GUI.

WP2 must include all partners so that the kernel evolves in agreement with the needs of everyone. WP3-4-5-6 should be relatively independent in term of technology. WP7 has to include WP2-3-4-5 leaders because it will rely on the developed modules.

WP2 and WP7 are likely to be bigger workpackages.

Here is a more detailed description of the planned content of the work packages:

WP2. CTK-Compliant Kernel

Several large development efforts already exist in the VPH community. As of today, there is no common framework that makes it possible to interconnect the multiple libraries and toolkits available in the community. The developed Kernel will propose mechanisms to connect them as modules through a common interface. This kernel will provide bridges and interfaces to ensure the interoperability of existing tools. Universal extension mechanisms will enable the integration of new components adhering to the specified interfaces.

This Kernel will implement prototypes for Data, Visualisation and Processing, implemented in the WP3, 4 and 5. Scripting capacities of these functional modules will be enabled through automatic wrapping. Additionally, a software development process compliant to ISO 13485 and the Medical Device Directive (MDD) will be applied within this WP (and WP6).

WP3. Extensible Data Integrator

This WP will integrate extensible data descriptors based on existing efforts in the VPH community both on the imaging and the modelling sides. These plugins will integrate conversion capacities between standard data formats allowing cross validation of models and processing.

WP4. Extensible Visualisation Integrator

Visualisation will be implemented as independent modules in order to reuse the best of the existing toolkits. Specific visualisation strategies will be implemented to cover the wide spectrum of data and models treated in the VPH community (within the range of scales covered).

WP5. Extensible Processing Integrator

Building upon major open source software for biomedical image processing and modelling, WP5 will interface these solutions with the proposed framework. Additional functionalities needed by the demonstrators will also be developed.

WP6. Biomedical Standards Compliance

In order to translate into the clinical environment, functionalities such as DICOM and PACS compliance are mandatory. It was also identified as a critical aspect by both the VPH-NoE and the CTK. WP6 will ensure that the platform will follow those standards.

WP7. Demonstrators and Dissemination

Uses cases of typical clinical workflows will be defined to guide the implementation of demonstrators. It will rely on the independent bricks developed in the previous workpackages. The objective is to demonstrate through practical examples the capacity of the platform to gather the different software components integrated in WP2-3-4-5-6. Public tutorials and training sessions will extend the dissemination of the platform to make the integration of new developers and users easier.

Requirements:

This project will follow the recommendation of the CTK working group (see CTK website for complete current requirements list), among which some major points are:

- BSD style licence for the foreground development
- C++ language for software development
- QT component used in priority if existing

External Advisory Board

In order to ensure compatibility with other developments related to the CTK, an external advisory board including the international members of the CTK steering committee will be invited to participate to regular meetings:

- Ron Kikinis, Harvard Medical School, Boston, MA, USA
- Will Schroeder / Stephen Aylward, Kitware Inc., Clifton Park, NY, USA
- Steve Pieper, Isomics, Cambridge, MA, USA
- Lawrence Tarbox, Mallinckrodt Institute of Radiology, St.Louis, MO, USA
- Gianluca Paladini, Siemens Corporate Research, Princeton, NJ, USA
- Kevin Cleary, Georgetown University, Washington DC, USA
- David Clunie, RadPharm, Princeton, NJ, USA
- Peter Hunter, Auckland Bioengineering Institute, Auckland, New Zealand (*not a CTK steering committee member but a major contributor to Data Models – FieldML*)

Budget: as we aim for a 3 years STRP, roughly speaking we would have in average 500k for WP (but it does not have to be an even distribution). Non-EU partners would not have budget, but we would side a bit to support their travelling to meetings.