

LINAC-MULTITOOL – AN OPEN SOURCE JAVA-TOOLKIT*

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Abstract

Dedicating more precious time to advanced research instead of spending it towards time-consuming routine tasks is a desirable goal in particle accelerator simulation and development. Requirements engineering was started at IAP in order to identify routine processes at our institute's R&D that can be automated or simplified. Results indicated that there were several areas to consider: Bead pull measurements, data processing and visualization for the beam dynamics code LORASR, CST field map processing for the use with TraceWin, conversion between different particle distribution data formats and more. Subsequently development of the LINAC-Multitool started to rationalize these processes and replace preexisting scripts also to ensure consistency of results and increase transparency and reliability of computation. In order to guarantee maintainability, expandability and platform independence, LINAC-Multitool is programmed using Java and will be open source. This contribution presents the current state of development.

SOFTWARE ARCHITECTURE

In preparation of choosing an appropriate platform (programming language, GUI toolkit, other libraries) three key factors emerged: Ease of use, maintainability and expandability. In conclusion Java, the probably most widely used programming language for the development of desktop applications, was chosen. It offers a convenient GUI toolkit (JavaFX [1]), which is bound to be supported for a long time by Oracle but still enables us to integrate all the features one would expect from a modern UI. The same goes for Java as a programming language and has been proven in the past as code that was written years ago can still be used. Other languages which sparked our interest however have undergone design changes in their past which broke source code compatibility and therefore were not as suitable as Java. In addition, we profited from the availability of a competent plotting framework – JFreeChart [2], which allowed us to introduce advanced features like data selection into our graphs and proved to be a stable base. As a team of two students and one supervisor kicked off this project, we chose to part the program along the lines of frontend and backend. The backend part includes all the parsing of files and most of the computational aspects for bead-pull measurements while the frontend part focuses on GUI, handling 3d field maps as well as particle distributions and better visualizations for LORASR-computations [3] in order to minimize friction and overall improve efficiency of implementation. In order to maximize our throughput we chose to minimize our re-

liance on expensive computational libraries wherever we could come up with more resource-conservative ideas. Figure 1 depicts an excerpt of the program architecture whose classes and functions can be categorized on the whole as *read*, *parse*, *analyze* and *visualize*.

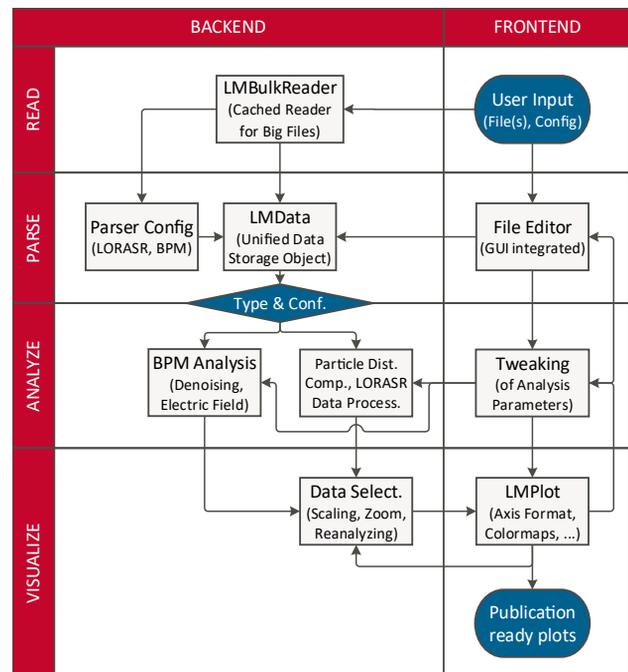


Figure 1: Schematic layout of the program architecture.

RANGE OF FUNCTIONS

An overview of the planned features for the LINAC-Multitool is given in Fig. 2. Up to now they can be divided into four parts: *LORASR*, *Bead Pull Measurement*, *Particle Distributions* and *CST Field Maps*. Finally, they will be documented in detail both in the source code and the user manual. The initial features are given in the following:

LORASR LORASR is a multi-particle tracking code for the beam dynamics design for all kind of DTLs, optimized for the "Combined Zero Degree Structure (KONUS)" lattices [4–8]. The code has been used for the beam dynamics design of many linacs in operation or under construction like GSI-HLI, -HSI and -pLINAC, CERN Linac 3, TRIUMF ISAC-I, HIT, MedAustron, HILac/NICA and MYRRHA. As its first code version was already developed in the late 80s, the possibilities for graphical user interactions were and are still not very wide-ranging. Nevertheless, the code has been significantly improved in the past decades with better gap field representation, a PIC space charge routine, error study

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Figure 4: Screenshot of the bead-pull measurement GUI.

3D Field Maps Electric and magnetic field data gained by simulations of CST EM STUDIO and CST MICROWAVE STUDIO [12] can be used in TraceWin after data format conversion. With LINAC-Multitool this conversion can easily be done, providing 3D field maps for TraceWin as an alternative to the use of elements with "hard edge"-approximation.

Outlook

Code development for the LINAC-Multitool has started successfully and first nightly build versions will be tested soon. An extensive feature list will tackle several routine tasks in R&D of linear accelerators and thus simplify workflows.

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