

Taking Full Control: Leveraging Software Customizability and Open-Source Hardware to Tailor FIB Instrument Controls

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As focused ion beam (FIB) technology has matured and increased in use over the past few decades, it has transformed from prototype instruments [1] into a largely commoditized and streamlined instrument platform. Today, multiple commercial manufacturers produce and deliver general-purpose FIB systems, primarily operated using dedicated software interfaces on the accompanying instrument PC. More specialized software with a higher degree of automation has been a key factor in enabling advanced applications such as 3D tomography [2], but again most of this control is implemented by the manufacturers. Beyond the instrument makers, there are a few examples of independently developed software that interact, directly or indirectly, with the instrument, such as for advanced beam path generation [3, 4]. More recently, a move towards scripting interfaces in FIB could lead to a proliferation of specialized and customizable control solutions. Furthermore, these implementations can be manufacturer agnostic, calling one of several manufacturer scripting interfaces. Such an architecture has for example been used for automated cryo-FIB lamella preparation in the open-source package SerialFIB [5]. But as of today, the majority of non-manufacturer developed FIB software still does not directly interface with the instrument, and most day-to-day operation for general-use FIBs is carried out in the main control software supplied by the manufacturer. While these interfaces are generally implemented in similar ways across different instrument maker, they are not identical, and every FIB platform is thus a little different from every other. Even when manufacturers have comparable FIB instrumentation, these differences between FIB software platforms can make for subtle but still tangibly different usage experiences.

Exploring the range of possibilities in for alternative controls in the FIB software can therefore be a highly rewarding exercise for advanced users. The main control methods for contemporary FIB systems are generally interactive elements in the control software itself and preset control panel features for properties such as focus, magnification, stigmation and so on. But several mature FIB interfaces now implement multiple ways to perform the same actions, including an expanding range of mouse and keyboard shortcuts. In this work we will explore a few of these customization options available for FIB operators and see how they can be leveraged, leading to more elegant usage experiences. At its simplest, this can involve subtle differences in implementation between keyboard and mouse control versus panel control, or the addition of readily available consumer hardware such as peripherals with macro support for easier access to keyboard shortcuts.

Going slightly farther, we will demonstrate the significant potential of simple, low-cost and self-made USB peripherals, leveraging keyboard shortcuts to provide fully customizable control panels without requiring any additional software on the instrument control PC. Finally, as scripting features in FIB systems continue to mature, the potential combination of both physical and digital customizability may well provide a wide range of new and interesting ways to truly take full control of the FIB [6].

References:

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