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Practical Remote Electron Microscopy – A Vendor's Perspective

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As microscopes have become more complex, they have become more specialized. Due to the expense of these instruments, not every laboratory that has a need for a specific feature on a microscope can afford such a machine. This has led to an increase in collaborative funding for instrumentation, with the instrument residing in one centralized facility. With this increased instrument complexity comes an increased sensitivity to the local environment of the microscope. For environmental effects such as thermal fluctuations, pressure fluctuations, air flow, mechanical vibrations and acoustic noise the operator is a major source. Remote operation of these instruments allows the microscope to be placed in the best possible environment while the operator can remain separated, in a comfortable environment. This ensures that the newest generation of microscopes can achieve their full potential.

Practical remote operation of electron microscopes has existed commercially for more than a decade. These early iterations often involved using software different from the microscope control software, as well as condensed versions of hardware, if any hardware at all. This meant that remote operation could be somewhat limited, with access to all features of the microscope not possible. This also meant that a remote operator needed to learn a new way to operate the microscope, as these remote versions were not the same as sitting in front of the instrument to operate it.

Current electron microscopes feature fully digital components and are operated by personal computers running standard operating systems. Through the development and improvement of commercial remote PC operation systems, this means that microscope remote operation is now identical to local operation and lends itself to a number of applications: remote operation for enhanced performance, instrument sharing, experiment collaboration, remote diagnostics, remote servicing, and remote teaching and training.[1,2] The JEOL JEM-ARM200F TEM can be remotely operated in just this fashion. A remote station is connected to the microscope and accessory computers through standard remote operating protocols over an Internet connection. Microscope control knobsets and a trackball for stage movement are connected via USB to the remote station, making remote operation of the ARM200F identical to operating the TEM locally.

JEOL SEMs use similar remote operating systems, such as VNC (Virtual Network Computing) software to allow a remote PC to log on to the SEM via an internet browser to have both live remote viewing and/or live remote control of the SEM. The real time lag in response can be as short as a few hundred milliseconds or as long as several tens of seconds depending on many factors such as: internet traffic, speed of any dedicated lines, and internal network bridging and security on both ends of the connection. VNC consists of two components. A *server*, which runs on the computer you want to remotely access (the SEM PC), and a *viewer*, which runs on the computer you are sitting in front of (the remote PC). Some customers have had success with using a similar type setup with a program called Radmin Viewer.

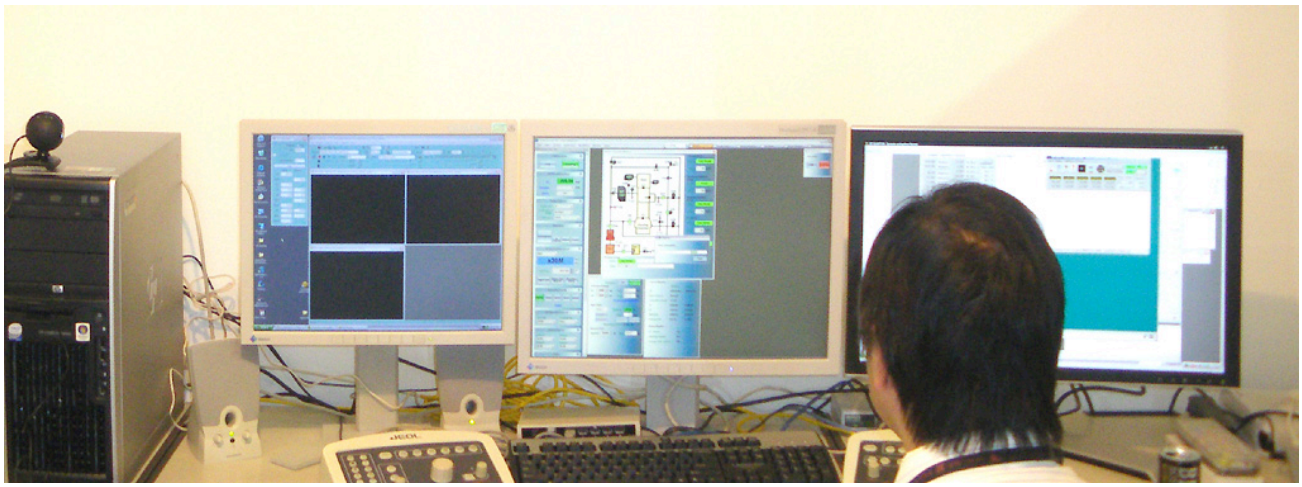

Figure 1. Remote operation of the JEM-ARM200F. The remote station uses the same GUI and hardware interface as local operation of the microscope.

Figure 2. Example of the VNC interface connected to an FEG-SEM (left), and InTouch Scope EDS interface (right) on an Apple iPad.

References

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[2] K. Fukushima, et al., *Microsc. Microanal.* 6 (Suppl 2) (2000) 1144

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