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Release Notes

Vevo® LAZR-X Imaging System Software V3.0.0

Vevo® 3100

PLEASE REVIEW THE FOLLOWING BEFORE UPGRADING YOUR SYSTEM

Changes Impacting User Experience

A number of system control buttons and functions have been changed, repositioned, or merged. Examples include a single "Measurements" button which now leads to a flyout menu, the "PRF" control now has a slider in addition to "Up" and "Down" arrows, extra TGC controls have been added for B-Mode, plus many other changes. Users who have customized the locations of certain buttons may notice some changes after upgrading.

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Release Notes for the Vevo® LAZR-X Imaging System Software V3.0.0

Photoacoustic imaging has opened up new possibilities for *in vivo* imaging in research areas such as oncology, molecular biology, neurobiology, and cardiology. FUJIFILM VisualSonics, Inc. (FF-VSI) leads the way with the Vevo LAZR-X Imaging System. We listened to the research community, including our customers and collaborators, and developed a system that's faster, more sensitive, and easier to use than ever. The next generation photoacoustic imaging platform is here: the Vevo LAZR-X Ultra High Frequency and Photoacoustic Imaging System.

This system takes the customizability, compact design, and workflow improvements in the Vevo 3100 Imaging System and builds in photoacoustic capabilities. The flexibility to customize imaging for specific applications, while providing intuitive guidance so you can get the best possible images in less time, has arrived. Hardware including new laser technology, a flexible light-delivery setup, and new animal handling for brain imaging make this cutting-edge system our most powerful multi-modal imaging platform ever.

By pairing the Vevo 3100 system with new near infrared laser technology, this major system release brings with it a host of enhancements and modifications including:

- PA-Mode Imaging – single wavelength, Oxy-Hemo, Spectro, and Multi-wavelength imaging submodes for a variety of photoacoustic imaging functionality.

- Auto-unmix – multi-spectral imaging feature, which performs automatic spectral unmixing and multiplexing upon scan completion for immediate visualization of results.

- Application-specific light delivery – the ability to use various light delivery options with different optical fibers to maximize imaging area, depth, and sensitivity based on the application.

- Extended wavelength range – access to 680 to 970 nm, as well as 1200 to 2000 nm.

- Fast wavelength switching – conduct photoacoustic imaging at frame rates up to 20Hz while switching wavelengths.

- Photoacoustic image guides – on-screen guide areas to ensure optimal photoacoustic image quality.

- PHANTOM application – image guidance and workflow customized for our Vevo PHANTOM contrast agent characterization hardware.

- Vevo BRAIN – mouse stereotactic frame and ultrasound neuroanatomical reference study.

- Workflow improvements – integration of infusion pump controls and frame markers for injection of contrast agents and tracking interventional procedures.

PA-Mode Imaging

Photoacoustic imaging functionality implemented on the system makes it truly multi-modal allowing for collection of data in several sub-modes. Single Mode allows for easy selection of and imaging with a single wavelength for fast photoacoustic imaging up to 20 Hz. Oxy-Hemo Mode collects data at two wavelengths and performs live unmixing for oxygen saturation and total hemoglobin visualization and quantification. Spectro Mode is a one-touch acquisition mode for scanning the entire spectral range (680 to 970 nm or 1200 to 2000 nm), useful for contrast agent characterization. Finally, Multi-Wavelength Mode is a new acquisition mode, developed by combining what was previously called "Nanostepper" and "Unmixing" on the Vevo LAZR Imaging System. Multi-wavelength simplifies the workflow of multispectral image acquisition so that multiple wavelengths can be acquired either based on the components the user wishes to image, the desired acquisition wavelengths, or a combination of both. The touchscreen interface and easily selectable wavelength controls take the guesswork out of image acquisition while providing the flexibility needed for advanced users.

Seeing More Matters

Auto-unmix

Once multispectral photoacoustic datasets are acquired, it is often necessary to visualize the results immediately to confirm the change in signal due to a manipulation. For this reason, we've implemented an optional workflow where a Multi-wavelength scan is immediately processed and spectrally unmixed to quickly generate multiplexed images upon completion of the scan. This applies to any acquisition where the components being imaged are known. Further adjustment of visualization parameters and basic quantification can be performed on the unmixed image.

Application-specific Light Delivery

Light delivery is the key to photoacoustic image quality. Success can depend heavily on the particular tissue, organ, or animal being imaged. To allow the flexibility necessary to cover many applications, we have completely separated the fiber optics from the ultra-high frequency ultrasound transducers. Transducer-specific jackets are used with the MX transducers and three separate high-efficiency optical fibers can be interchanged within these jackets. This allows for pairing low frequency transducers with narrow focused light to enhance depth and sensitivity for applications such as brain imaging, or using wider fibers for enhancing the image width for whole-body applications.

Extended Wavelength Range

In addition to the 680 to 970 nm range typically used for non-invasive, *in vivo* photoacoustic imaging, our new laser technology allows access to the 1200 to 2000 nm (or NIRII) range for applications such as lipid imaging or a broader range of contrast agent applications. This range can be used the same way as the typical range allowing for Spectro, Multi-wavelength, and Multiplexer for chromophore characterization and NIRII spectral unmixing.

Fast Wavelength Switching

Our new laser technology is capable of tuning the wavelength between pulses, resulting in faster multispectral acquisition. In addition, we have improved single-quadrant imaging so that energy-corrected images can be acquired at the repetition rate of the laser (20 Hz). This means you can now get a multispectral frame which contains 5 wavelengths at a rate of up to 4 Hz (full image width at 1 Hz). With up to 5 times the imaging speed of other platforms comes the ability to more closely resolve perfusion curves of injected agents or visualize and measure rapid changes in oxygen saturation.

Photoacoustic Image Guides

Experience from the field and feedback from our users has informed us how best to optimize imaging parameters for optimal image quality. We have taken those lessons and implemented them as guides on the screen so users can quickly and easily position their subject and transducer. Now, when the laser is turned on, the light delivery is optimized for the best depth and sensitivity while artifacts are eliminated or minimized. The guides also help the user when using different optical fiber arrangements to know where to best position their target according to the fiber being used. These guides can be toggled on and off so they do not interfere with the image itself once proper positioning is achieved.

PHANTOM Application

Designed to work with our Vevo PHANTOM contrast agent imaging chamber and tubing, this application makes imaging and characterizing photoacoustic contrast agent samples simple and reproducible. On-screen guides facilitate positioning of the phantom for consistent image quality and reproducibility while automatically-generated regions of interest and subsequent quantification using Spectro Mode make for one-touch characterization. Spectral data can be saved into the software and used for Multi-wavelength acquisition and spectral unmixing.

Vevo BRAIN

For mouse neuroimaging applications, reproducible and easy animal positioning is achieved using a photoacoustic-compatible stereotactic frame with integrated anesthesia delivery. The frame easily mounts to the mouse imaging platform (version II) and is accompanied by a high-resolution ultrasound neuroanatomical atlas of an excised CD-1 mouse brain. This can be used during live imaging for more accurate positioning in the anatomical region of interest.

Workflow Improvements

 A common application for multispectral photoacoustic as well as Nonlinear Contrast imaging is injection and monitoring of a contrast agent bolus in a live animal. This has been greatly facilitated by integrating the controls for the Vevo Infusion Pump into the system software, and including a frame marker functionality to indicate on the recorded cine loop where an event (such as an injection or other manipulation) occurred.

Vevo LAB Workstation Software

FUJIFILM VisualSonics, Inc. (FF-VSI) develops the Vevo LAB Workstation Software as a unified post-acquisition data management and analysis environment for studies acquired with a range of Vevo Imaging Systems (currently supported systems: Vevo 1100, Vevo 2100, Vevo LAZR, Vevo 3100, and Vevo LAZR-X).

For further information on V3.0.0 of Vevo LAB, which accompanies this release, please see "PN53089 Release Notes for Vevo LAB Software V3.0.0".

For more information on our technology, products, and applications please visit

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