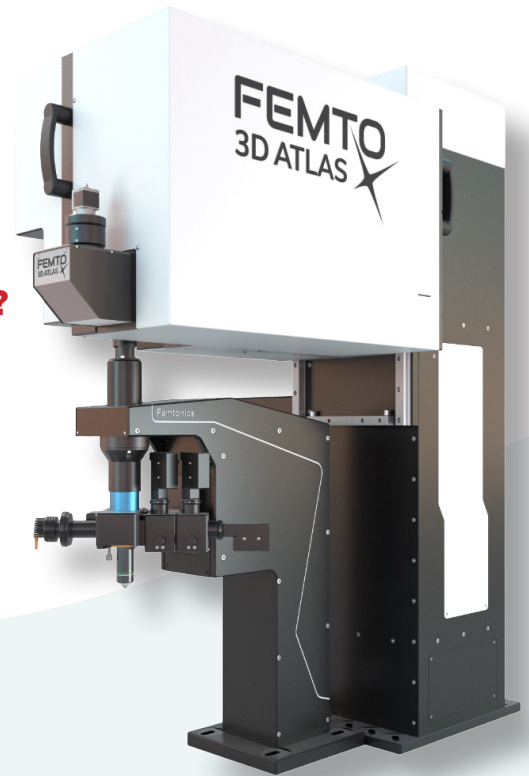# BLOOD FLOW TRACKING AND ANALYSIS

FEMTO
3D ATLAS

How to accomplish blood flow imaging with Atlas?

➤ **Compatibility** with blood flow indicatos

➤ Two pairs of acousto-optic crystals for XY and Z **rapid 3D focusing**

➤ 4D Beam Conditioning Unit for **stabilization of laser beams**

➤ Two **different wavelength** two-photon laser sources

➤ **Fast switching** between two lasers in case of quasi-simultaneous dual excitation

➤ **Simultaneous calcium and blood flow imaging** is possible

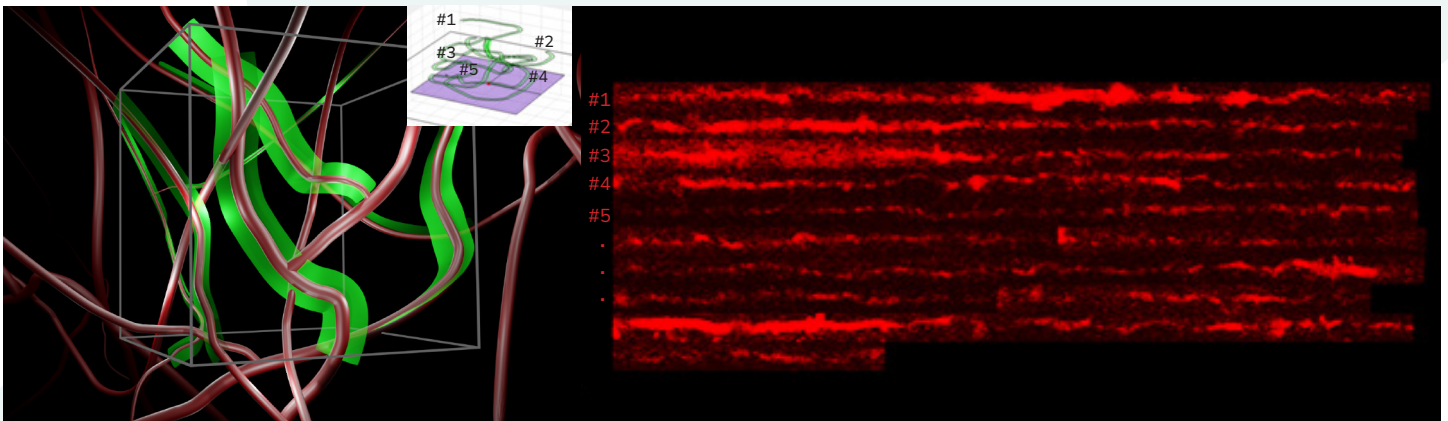## Tracking complex 3D blood flow?

Figure 1: Maintaining a proper scanning speed for 3D blood stream measurement, the FEMTO3D Atlas is able to scan an up to 5 mm long ribbon network. A. 3D reconstruction of the ribbon pattern laid down to measure blood flow in the mouse cortex. B. Blood stream visualization of a 4,78 mm long 3D ribbon-network; scanning speed: 7 Hz.
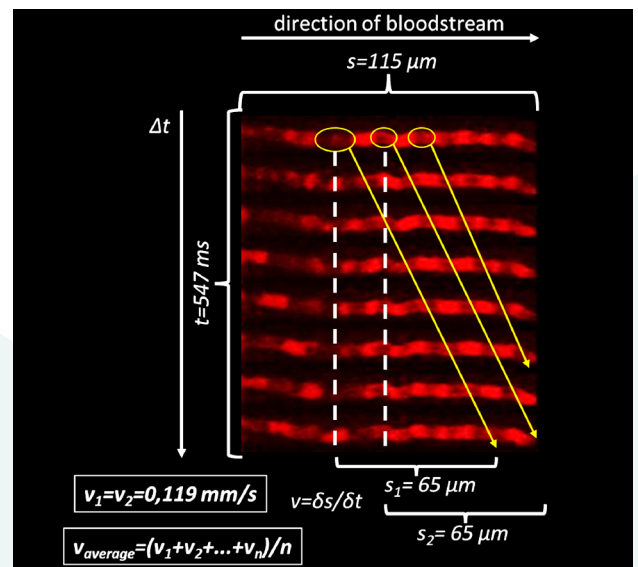
RIBBON SCANNING METHOD FOR BLOOD FLOW MONITORING

➤ **High Efficiency:** The ribbon scanning method offers fast, real-time blood flow monitoring by focusing on a ribbon-shaped area of interest (Fig 2A).

➤ **Reduced Artifacts:** The technique significantly minimizes motion artifacts, nearly eliminating them with real-time motion correction.

➤ **Detailed Visualization:** Provides clear and detailed images of blood vessels and flow patterns.

➤ **Dynamic Monitoring:** Ideal for capturing transient and dynamic changes in blood circulation.

➤ **Vascular Health Insight:** Enhances understanding of vascular health and disease through rapid imaging.

Can you measure blood flow velocity?

METHOD FOR MEASURING BLOOD FLOW VELOCITY USING 3D TWO-PHOTON IMAGING

1. **Capture a 3D Image:** Obtain a 3D image of blood vessels at a specific depth (e.g., ~200 μm) and visualize the blood stream within a selected ribbon-shaped region.

2. **Identify Red Blood Cells:** Focus on individual red blood cells (RBCs) in the bloodstream, marking them in the image.

3. **Create a Montage Image:** Generate a montage image showing the movement of RBCs over time.

4. **Calculate Speed:** Measure the speed of each RBC (v1, v2, ... vn) by analyzing their movement across the montage frames.

5. **Determine Average Velocity:** Calculate the average blood flow velocity in a specific vessel or capillary section by averaging the speeds of the RBCs.

direction of bloodstream
$s=115 \ \mu m$
Δt
$t=547 \ ms$
$v_1 = v_2 = 0{,}119 \ mm/s$
$v = \delta s / \delta t$
$v_{average} = (v_1 + v_2 + ... + v_n)/n$
$s_1 = 65 \ \mu m$
$s_2 = 65 \ \mu m$

Is it possible to combine blood flow measurements with calcium measurements?

- Research of cardiac diseases may be supported by a combined method of **simultaneous Ca²⁺ activity and blood flow imaging**.

- Using the FEMTO3D **Atlas Dichro** with two laser **sources of different wavelengths**, blood cell movement and neuronal activity can be measured at the same time.

- **Fast switching** between the two laser sources makes it possible to image **quasi-simultaneously** on two different emission wavelengths.

- This method is useful for studying the detrimental consequences of stroke on vascular conditions, neuronal damage, regeneration processes, etc.
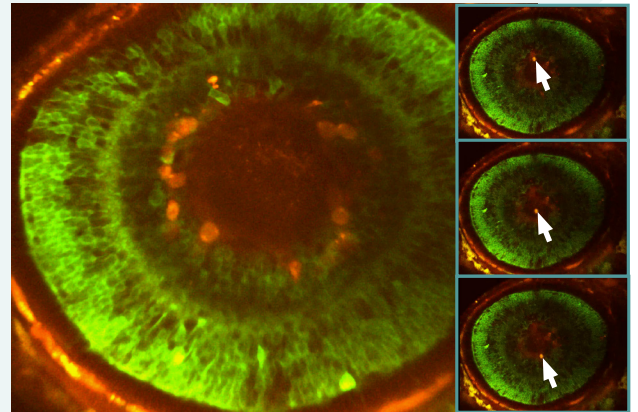

Figure 3: In vivo imaging of blood flow in zebrafish eye. RED: tdTomato sparse labelled blood cells. GREEN: GCaMP6 labelled neurons

Learn more:

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