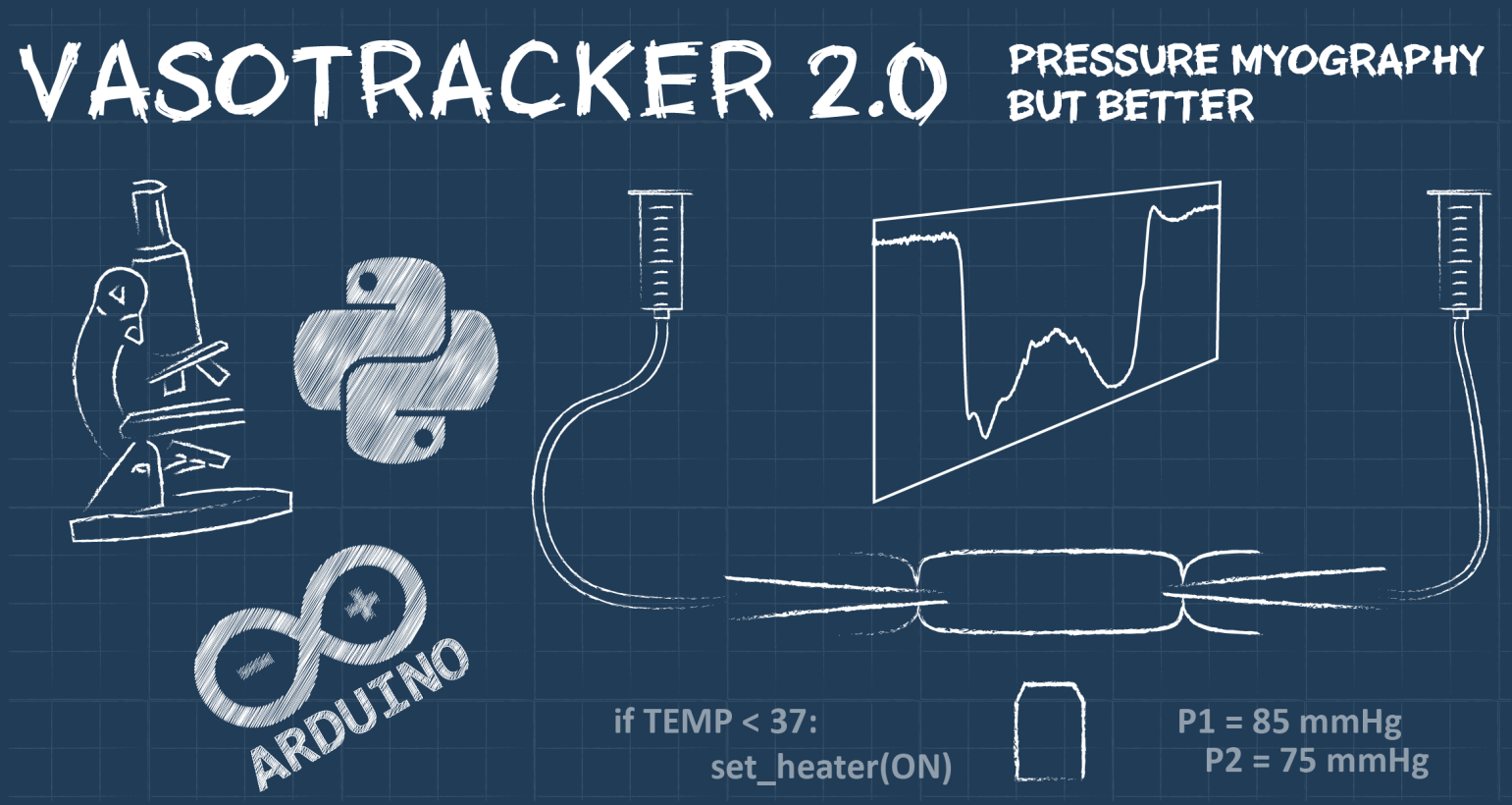
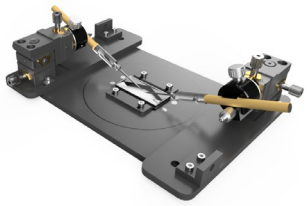


VasoTracker 2

System Guide



January 2025

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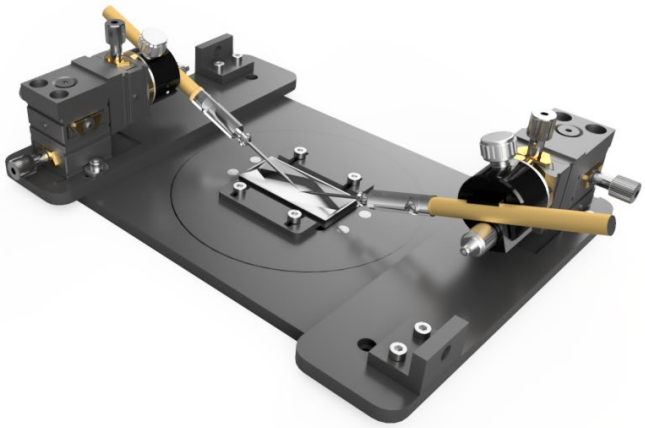

Affordable, Open-Source Pressure Myography

VasoTracker 2.0 is a cost-effective, open-source system designed to measure and track the diameter of isolated, pressurized blood vessels. This accessible alternative to commercial pressure myograph systems costs approximately **£13,500**, roughly **25% of the cost** of commercial options.

Whether you're new to vascular research or seeking to optimize your lab's setup, VasoTracker 2.0 provides a modular and customizable solution. This guide provides an overview of core and additional components, alongside recommendations, to help you create a complete pressure myography system.

Core VasoTracker Components

Approximate build cost: £3320

- **Bath Chamber (~£2,500)**
  - https://vasotracker.com/pressure-myograph/
- **Temperature & Pressure Monitor (~£320)**
  - https://vasotracker.com/temperature-pressure-sensor/
- **VasoMoto Pressure Control System (~£500)**
  - https://vasotracker.com/vasomoto/
- **VasoTracker Software (free)**
  - https://vasotracker.com/software/

Additional Components for a Complete System (approximate cost for new components: £10,150)

To fully set up a VasoTracker-based pressure myography system, the following are also required. Approximate cost for new compponents: £10,150.

- **Microscope** (inverted preferred, ~£5000)
- **Camera** (compatible with microscope, ~£400)
- **Laptop Computer** (for data capture and analysis, ~£500)
- **Temperature control system** (~£4250**)**

For more information on building your own VasoTracker system, visit https://vasotracker.com/.

Citing VasoTracker

For citation details, please visit: https://vasotracker.com/publications/

Recommended Microscopes

The VasoTracker pressure myography chamber offers flexibility for researchers, being compatible with both inverted and upright microscopes. We suggest an **inverted trinocular microscope** with a camera port for optimal use.

Inexpensive Microscope Options

Most microscopes will work, and many researchers will be able to find a suitable microscope lying around in their department. A good source of inexpensive second-hand microscopes is eBay (**we have purchased Olympus CK40 and CKX41 microscopes for less than £1000 each**).

New Microscope Recommendations

At Strathclyde, we like Nikon microscopes, so here are two models that fit different budgets:

1. **Nikon Ts2R (Price ~ £8,000)**

- **Requirements:**
  - Camera port & c-mount adapter
  - Objectives (4x, 10x, 20x, 40x).
- **Benefits:**
  - This microscope has a very nice mechanical stage.
  - Nice optics.
  - Can be configured in any way you want (fluorescence options)

https://www.microscope.healthcare.nikon.com/products/inverted-microscopes/eclipse-ts2r

2. **Nikon Ts2 (Price ~ £4,000)**

- **Requirements:**
  - Camera port & c-mount adapter
  - Objectives (4x, 10x, 20x, 40x).
- **Benefits:**
  - Cheap
  - Nice optics
- **Drawbacks:**
  - The stage! We remove it, and just sit the myograph on directly on the microscope. This is a pain if you want fine control of where the artery is.

https://www.microscope.healthcare.nikon.com/products/inverted-microscopes/eclipse-ts2

Recommended Cameras

The VasoTracker pressure myography software is powered by Python 3 and μManager 2.0. This combination facilitates lots of different camera compatibility.

Inexpensive Camera Options

If a camera works in uManager 2.0, then you should be able to get it to work with VasoTracker. So any cheap camera that works with OpenCV should work.

New Camera Recommendations

We have fully tested and regularly use the following cameras:

1. **Thorlabs CS165MU/M (Price ~ £400)**

- **Requirements:**
  - Camera (~£380)
  - C-mount adapter (~£18)

Camera: https://www.thorlabs.com/thorproduct.cfm?partnumber=CS165MU/M
C-mount adapter: https://www.thorlabs.com/thorproduct.cfm?partnumber=SM1A10

2. **Basler Ace 2 (a2A1920-160um)**

- **Requirements:**
  - Camera (~£380)
  - USB 3.0 Cable (~£6)

Camera: https://www.baslerweb.com/en/shop/a2a1920-160umbas
USB 3.0 Cable: https://www.amazon.co.uk/dp/B0CQCNTLZM/

3. **The Imaging Source (DMK 42AUC03, Monochrome)**

- **Requirements:**
  - Camera (~£200)
  - USB 3.0 Cable (~£6)

Camera: https://www.theimagingsource.com/en-us/product/industrial/2u/dmk42auc03/
USB 3.0 Cable: https://www.amazon.co.uk/dp/B0CQCNTLZM/

Recommended Computers

For optimal performance when running the VasoTracker system, we recommend a desktop or laptop with the following specifications:

Recommended Desktop Specifications

- **Operating System:** Windows 10 or newer
- **Memory (RAM):** 16 GB minimum
- **Storage:** SSD (Solid State Drive) for efficient data handling
- **Processor:** Intel i5 or higher for robust performance

An HP desktop with these specifications generally costs around **£700**. Desktop setups can be particularly advantageous in lab environments, offering reliable integration with peripherals and long-term stability for intensive data processing.

Example desktop computer:

HP Pro Mini 400 G9 Business Desktop - Core™ i5

- **Link:** https://www.hp.com/gb-en/shop/product.aspx?id=997S0ET&opt=ABU&sel=DTP
- **Cost:** £710

Recommended Laptop Specifications

- **Operating System:** Windows 10 or newer
- **Memory (RAM):** 16 GB minimum for smooth data processing and analysis
- **Storage:** SSD (Solid State Drive) to ensure faster boot times and efficient data handling
- **Processor:** Intel i5 or higher for adequate processing power

A HP laptop with these specifications typically costs around **£1000+**. We really do recommend a desktop option though.

Example laptop computer:

HP EliteBook 840 G11 14” Business Laptop – Core™ Ultra 7

- **Link:** https://www.hp.com/gb-en/shop/product.aspx?id=8A4U3EA&opt=ABU&sel=NTB&_gl=1
- **Cost:** £1320

Temperature Control Options

Temperature Monitoring

The **VasoTracker Temperature & Pressure Monitor** provides real-time temperature monitoring within the bath chamber. A sensor placed in the bath chamber connects to VasoTracker 2.0 software, offering continuous temperature data for precise control. The device can be built for ~£320.

Full build details here: https://vasotracker.com/temperature-pressure-sensor/

Temperature Control

To regulate temperature, VasoTracker 2.0 relies on external temperature control systems. Here are some recommended setups with estimated costs as of October 2024:

1. **Hotplate Stirrer & Peristaltic Pump (~**£3500**):**
    - Hotplate Stirrer (~£500)
    - 2-channel Masterflex Ismatec Reglo Peristaltic Pump (~£3000)

2. **Heated Circulator & Peristaltic Pump (~**£4250)
    - Optima T100 Heated Circulating Bath (~£1000)
    - Radnoti Heating Coil (1.5 mL) (~£250)
    - 2-channel Masterflex Ismatec Reglo Peristaltic Pump (~£3000)

3. **Inline Solution Heater & Peristaltic Pump (~£5500)**
    - Warner SH-27B inline solution heater & TC-324C Controller (~£2500)
    - 2-channel Masterflex Ismatec Reglo Peristaltic Pump (~£3000)
    -

Solution Control

To maintain a constant solution volume in the bath, it is recommended to use **a 2-channel peristaltic pump**.

Adjusting the Bath Volume:

- The VasoTracker 2.0 chamber offers two bath configurations:
    - **Low-volume chamber:** 2 mL capacity
    - **Higher-volume chamber:** 3.5 mL capacity
- Adjust bath volume by raising or lowering the perfusion plumbing.

Tip: Using larger tubing on the outflow side helps prevent overflow if both channels of the peristaltic pump are set to the same speed.

Pressure Control Options

Pressure Monitoring

The **VasoTracker Temperature & Pressure Monitor** provides real-time pressure monitoring via two inline pressure transducers connected to the VasoTracker bath chamber. The device continuously streams pressure data to the VasoTracker software. The device can be built for ~£320.

Full build details here: https://vasotracker.com/temperature-pressure-sensor/

Pressure Regulation Options

VasoTracker 2.0 supports two main types of pressure regulation systems (estimated costs as of October 2024):

Hydrostatic Gravity Columns (for experiments requiring flow through the blood vessel lumen)

1. **Gravity-driven perfusion system (cost ~£400):**
    - **Setup:** 50 ml syringes mounted on magnetic holders connected to each side of the pressure myograph.
    - **Operation:**
        - Maintain constant pressure without flow by setting syringes at equal height.
        - Adjust pressure by raising or lowering the syringe height.
        - Introduce flow without changing pressure by moving syringes up/down in opposite directions.
    - **Monitoring:** Pressure can be observed using the **VasoTracker Pressure Monitor.**

Pressure Servo Controllers (for no-flow experiments, e.g. assessing myogenic tone)

1. **VasoMoto Open-source Pressure Servo Controller (cost ~£200):**
    - **Features:** Integrates directly with VasoTracker via USB, allowing VasoTracker software to control it (does not require the VasoTracker Pressure Monitor).
    - **Full build details here:** https://vasotracker.com/vasomoto/

2. **Commercial Pressure Servo Controller Systems (e.g., Living Systems LS-PS-200. ~£4000):**
    - VasoTracker software can control the LS-PS-200 via the following peripherals (full instructions can be found in the VasoTracker software manual):
        - National Instruments DAQ Board (e.g. USB-6001, ~£275).
        - A BNC cable (e.g. Amphenol 115101-35-M1.00, ~£25)
        - A BNC breakout cable (e.g. Pomona 4969, ~£15)

www.vasotracker.com