

Apparatus for simulating a pulse-pressure and heart beat



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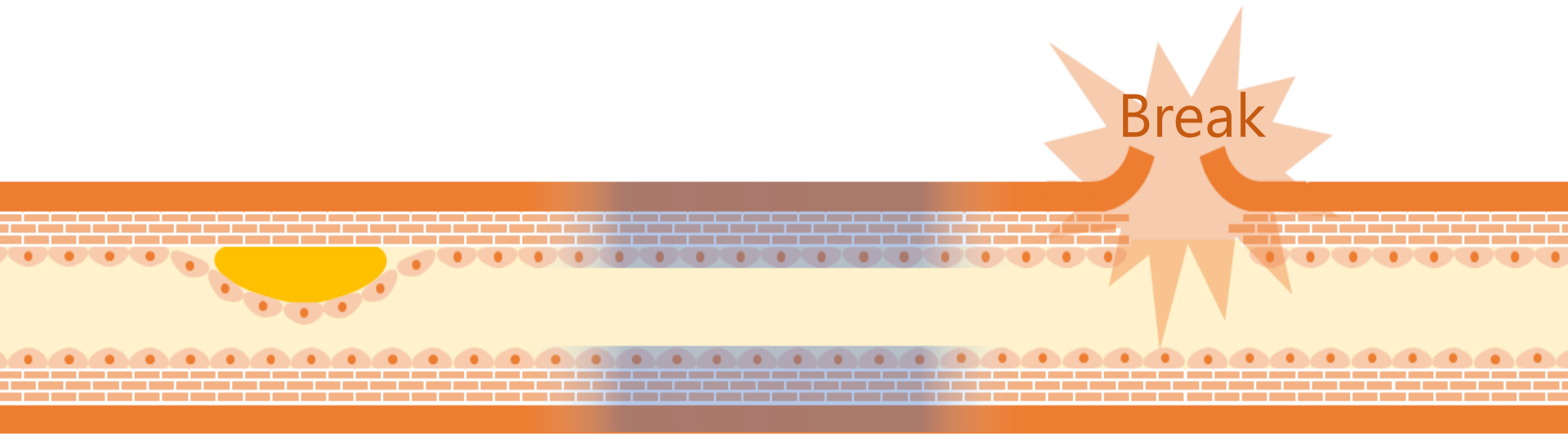
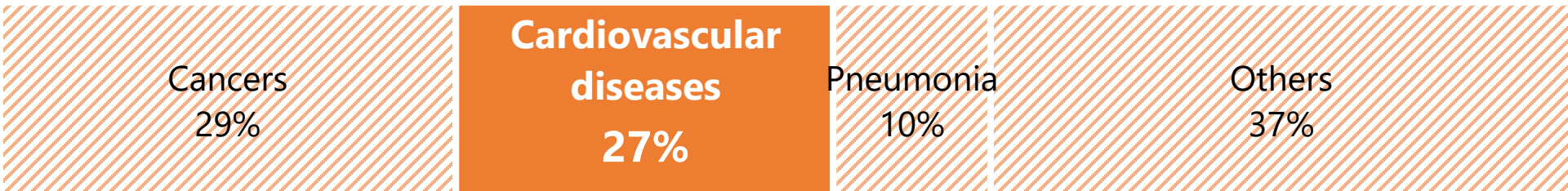
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Background

Causes of death in Japan



Background


In vivo experiments...

バイオメカニクス

 *Ko-shinsyu*
High-
invasiveness

 *Ko-cost*
High-cost

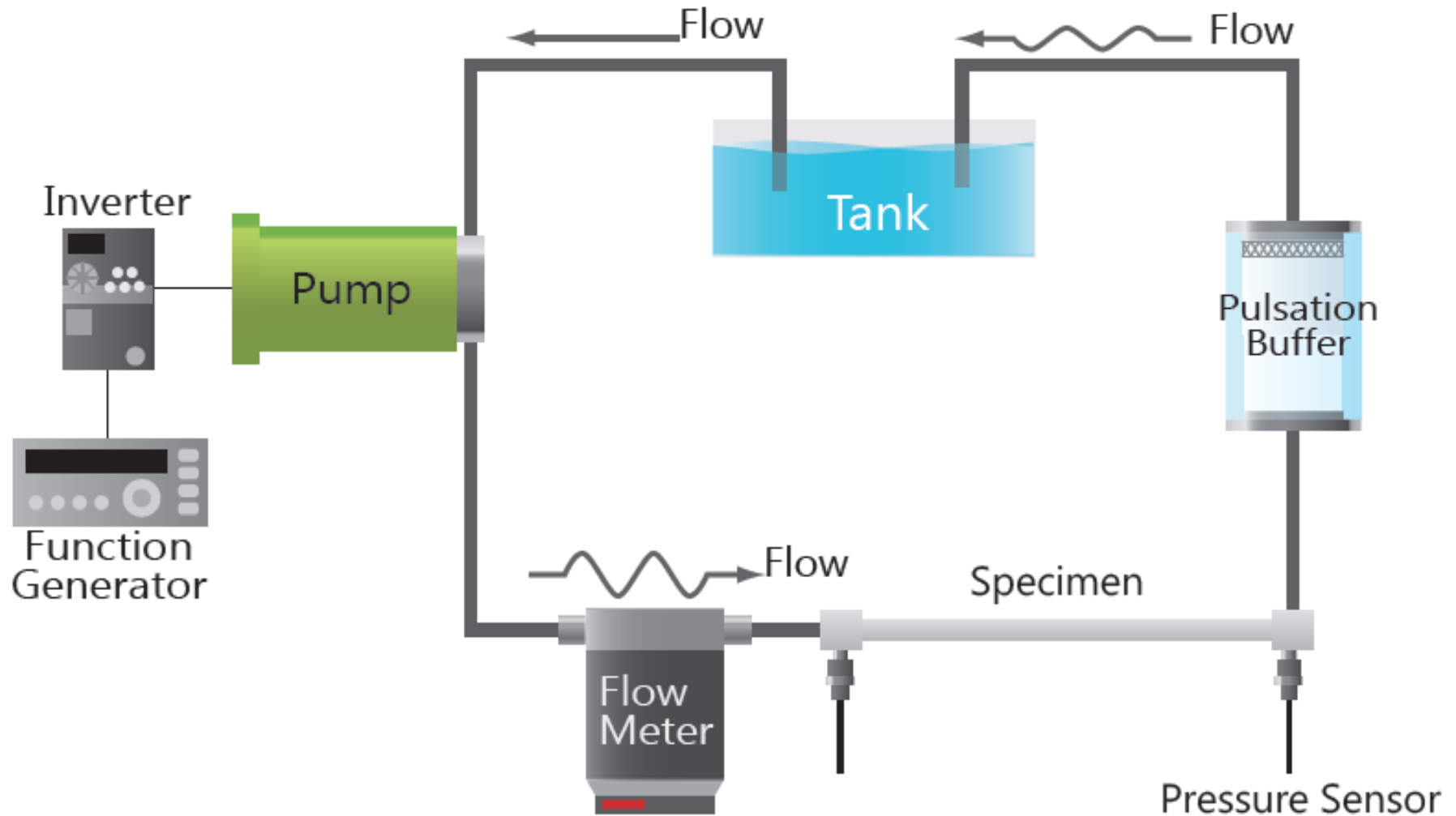
Kotaisa
Individual
difference


3K

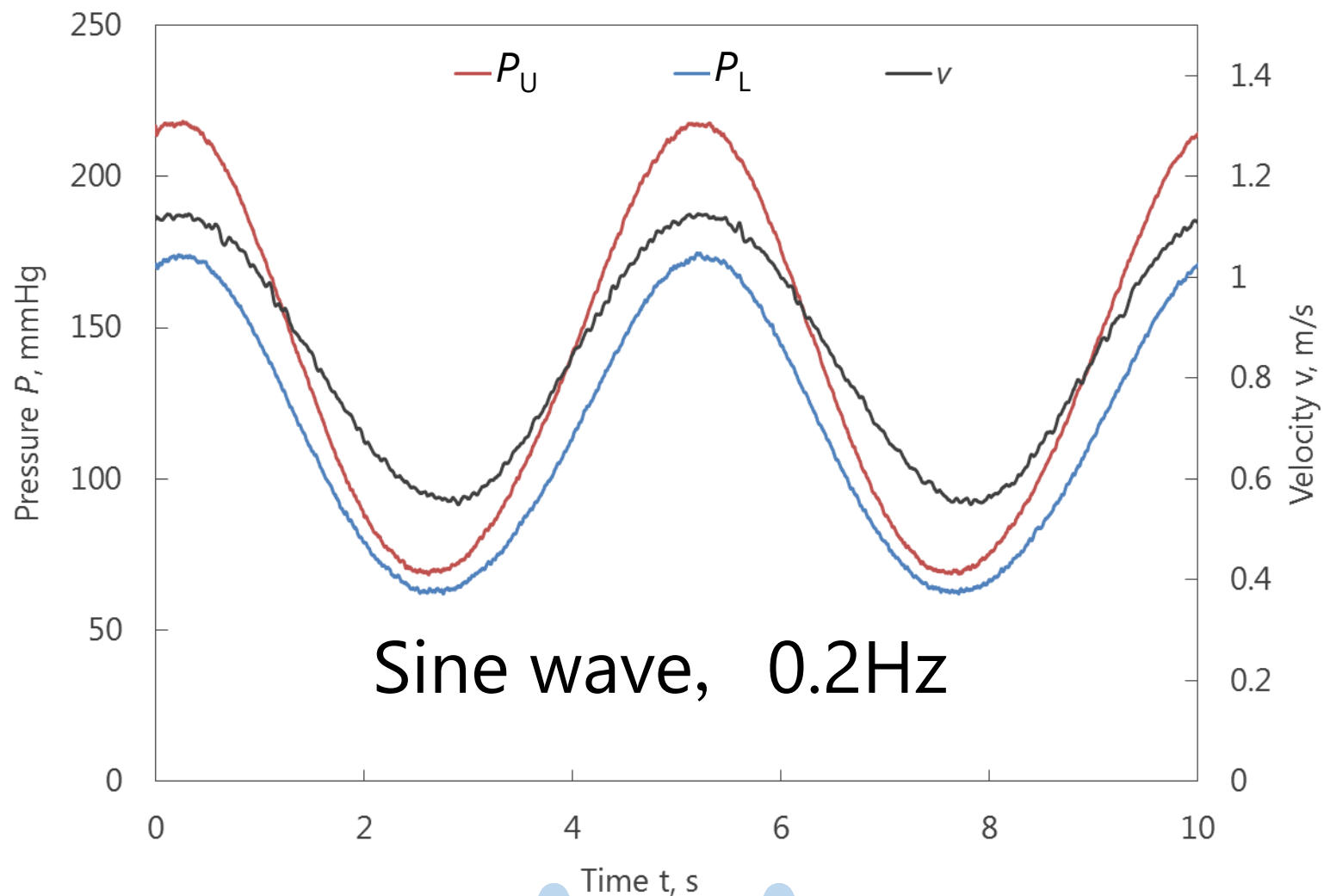
Difficult to develop systems

Development of pulsation simulators

Pulsation simulator 1



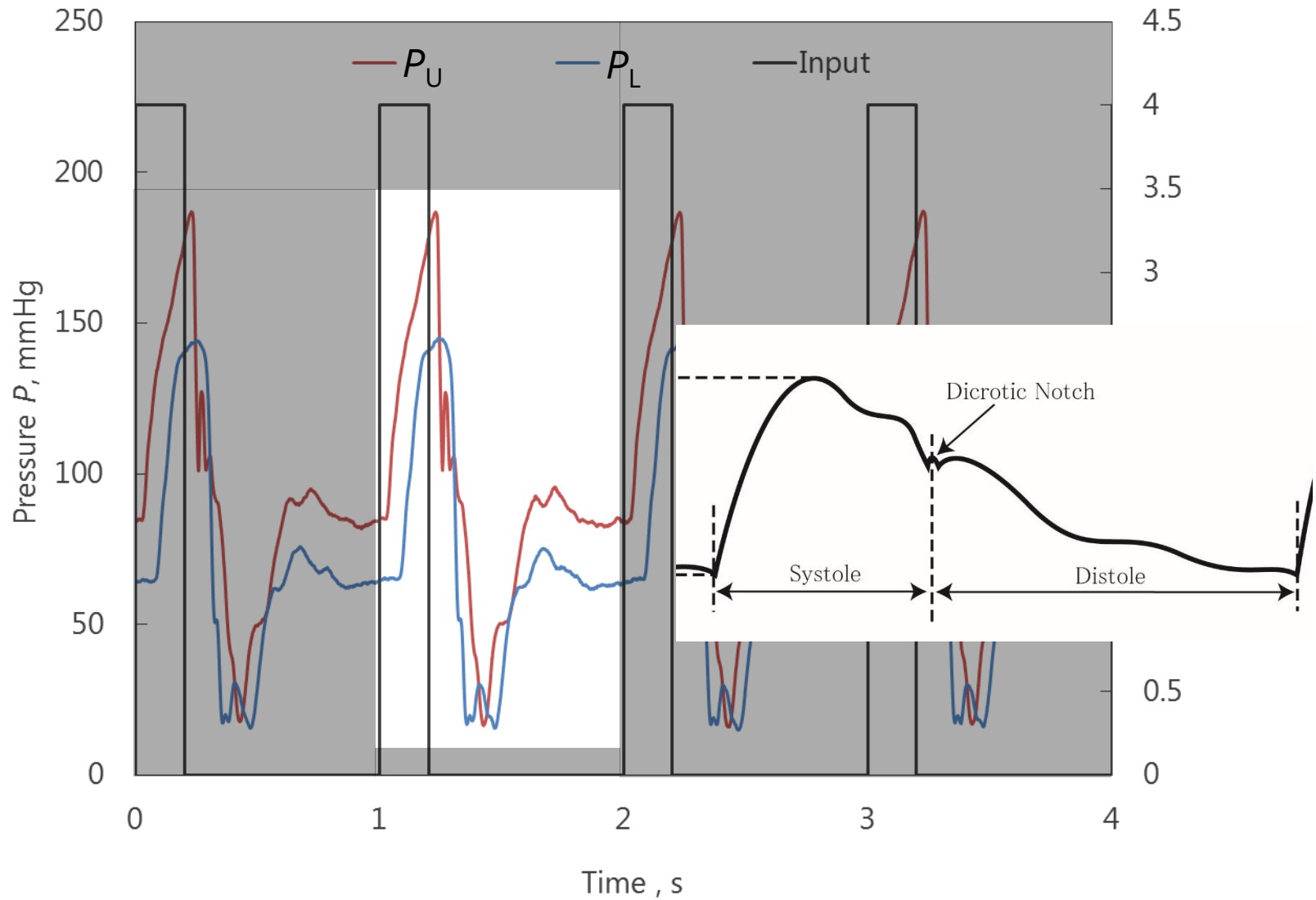
Pulsation simulator 1



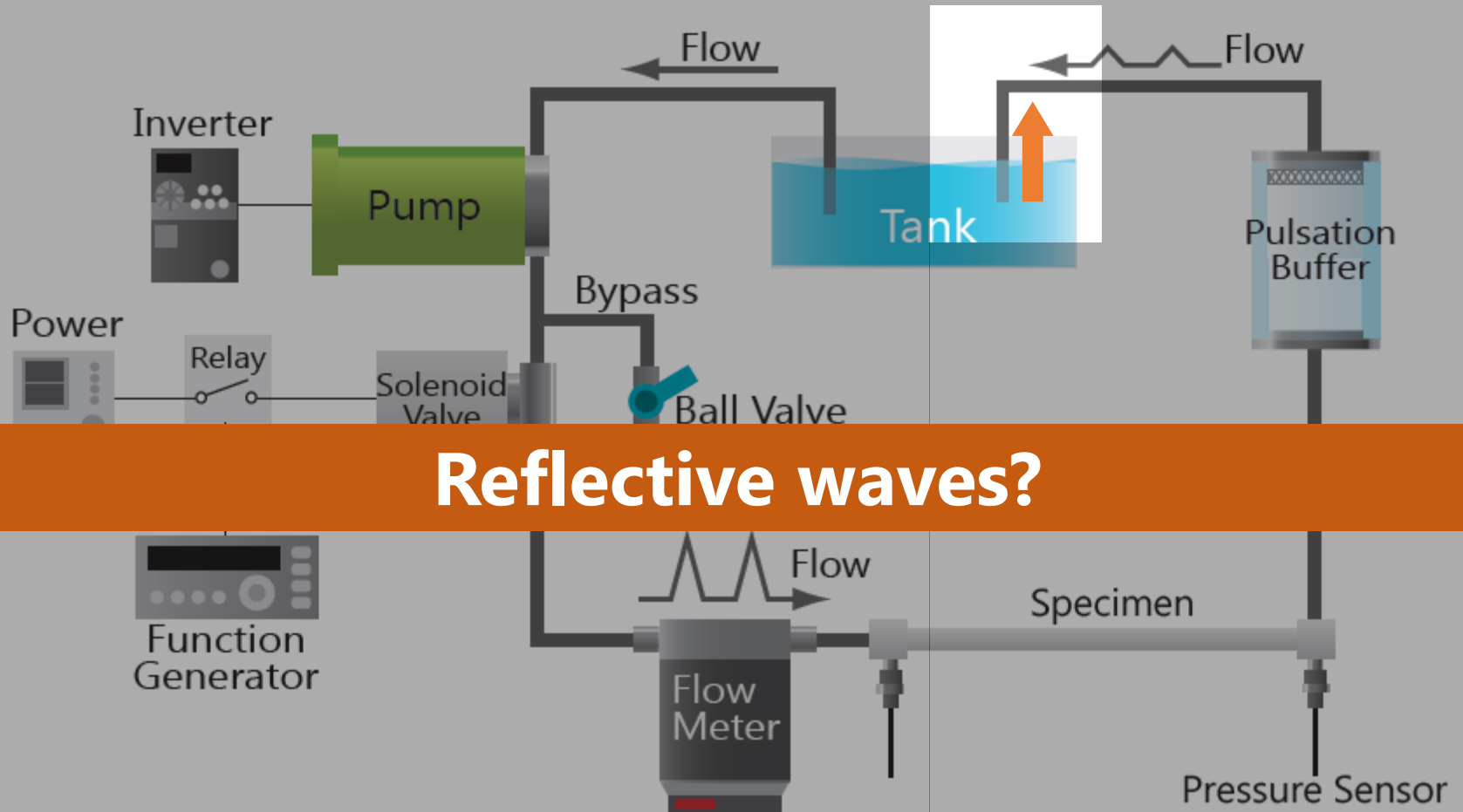
In vivo like pulsation!



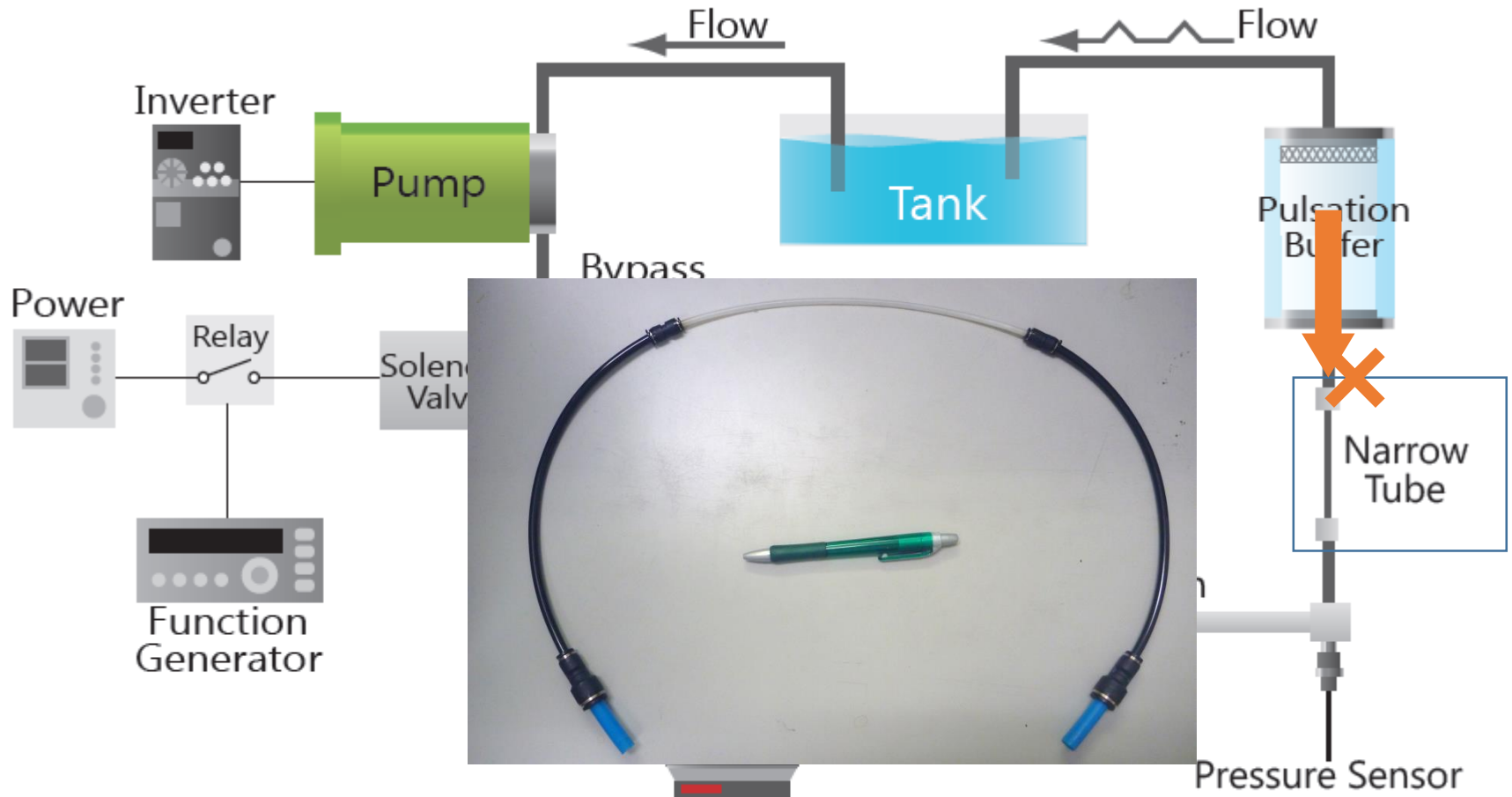
Change of waves



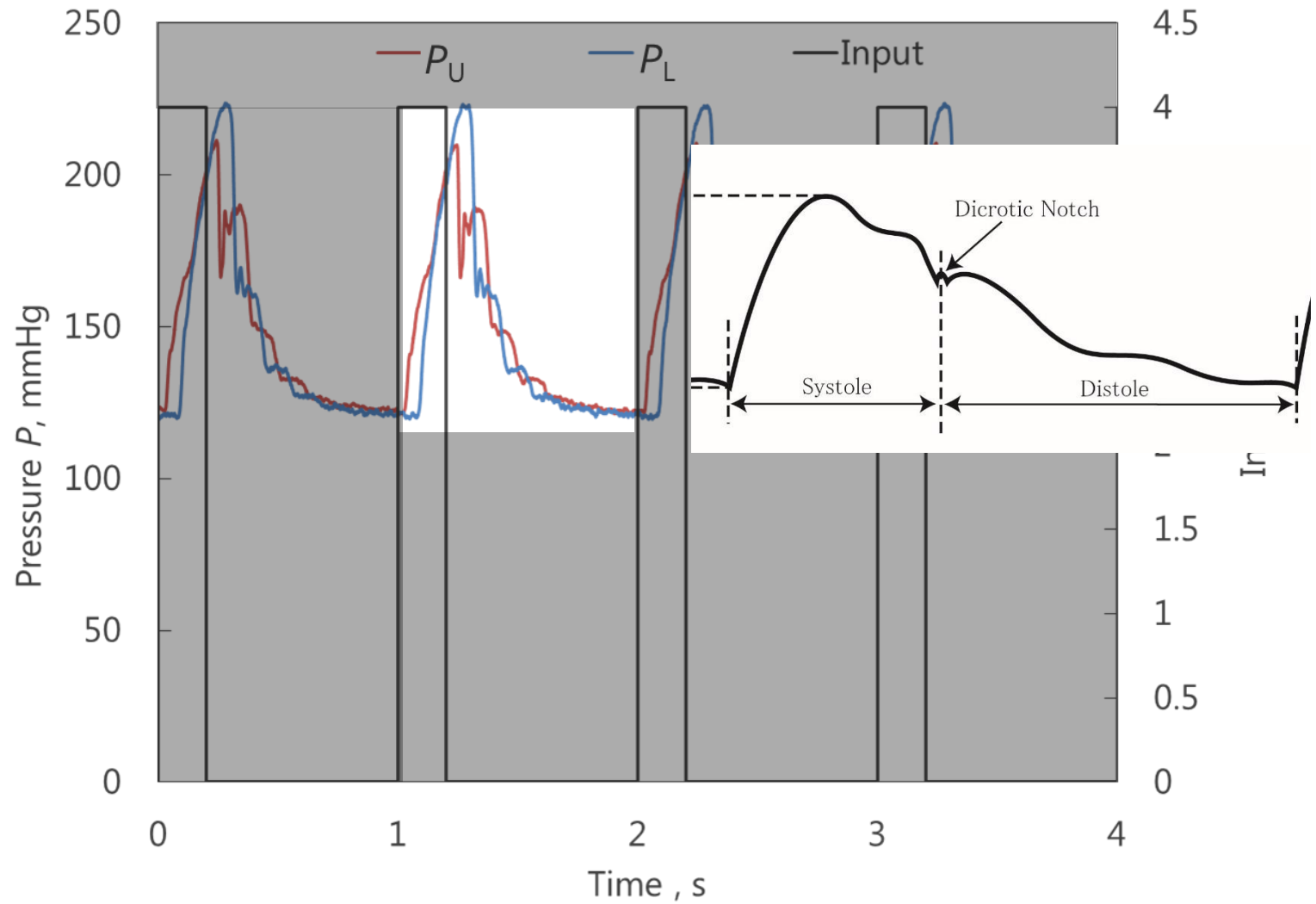
電磁弁導入後の圧力波形



Increase in flow resistance

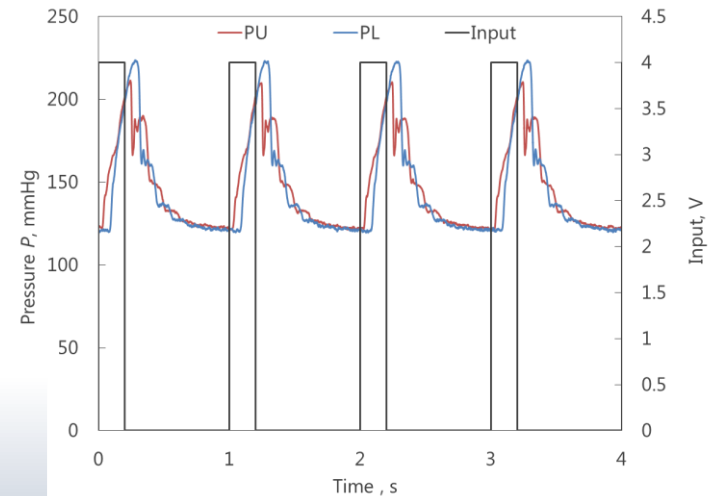
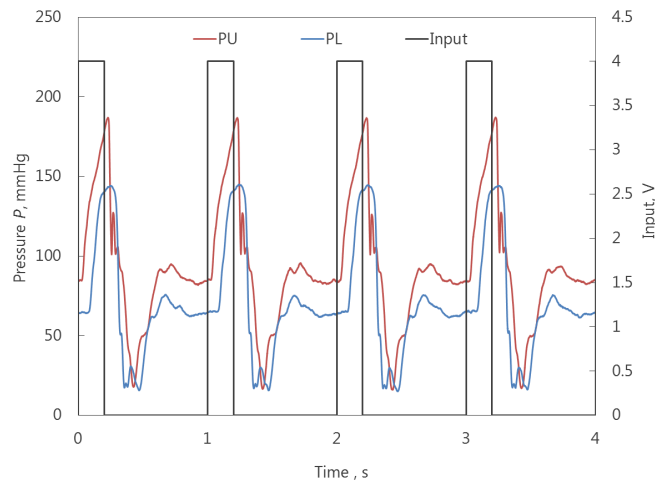


Change of waves



Pulsation simulator

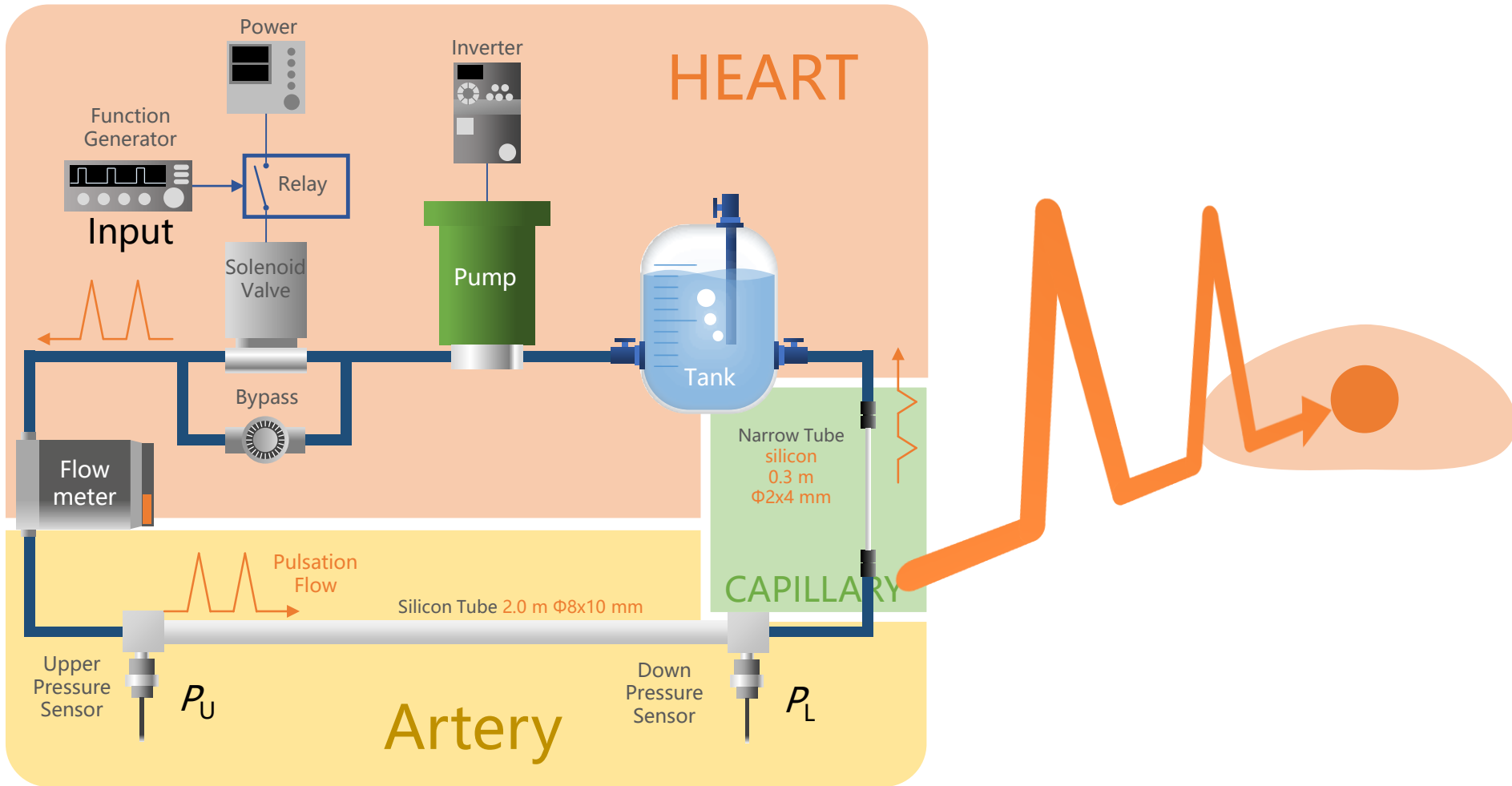
- Solenoid valve to change waves similar to pulse pressure
- Narrow tube to increase flow resistance



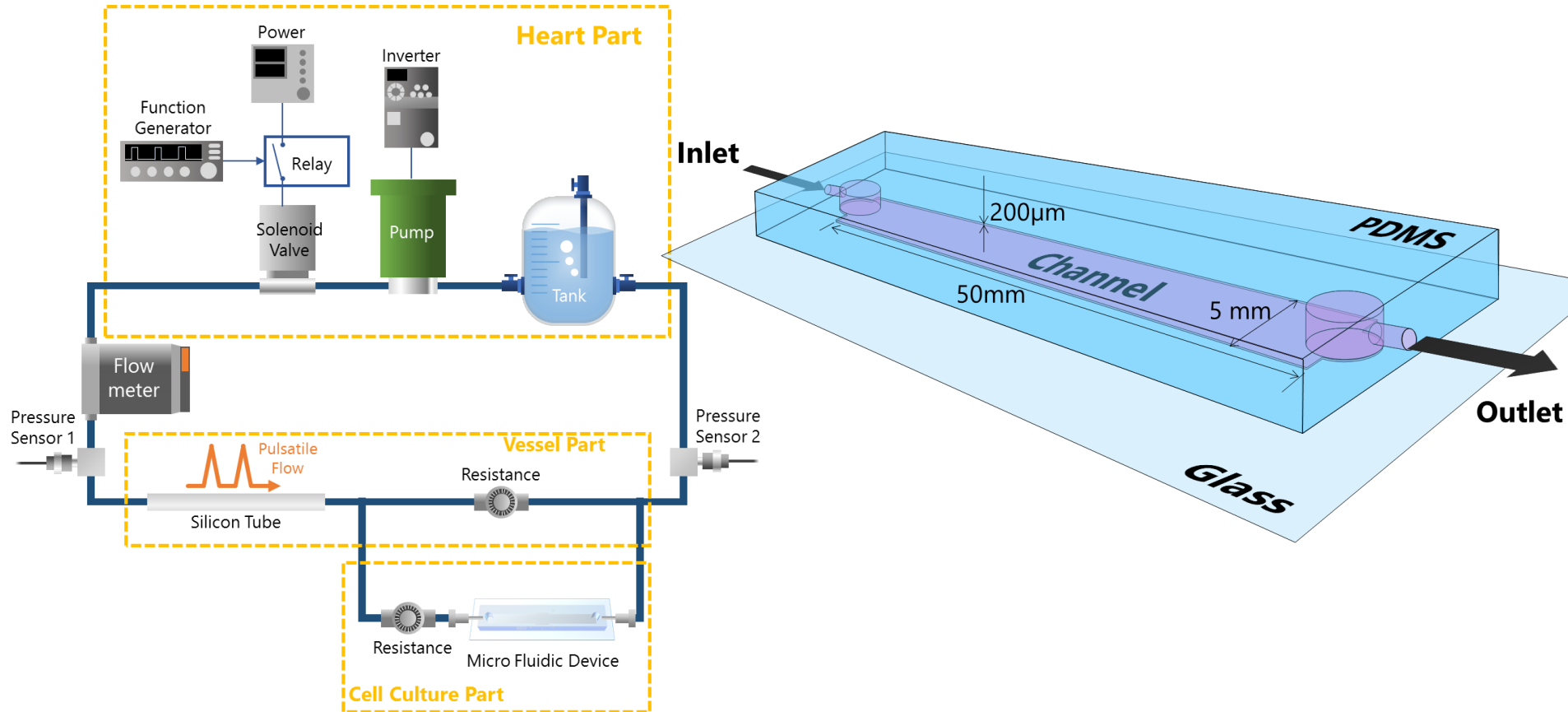
Realization of In vivo like pulsation!

Application for studying vascular mechanobiology

Blood-vessel cells under pulse pressure

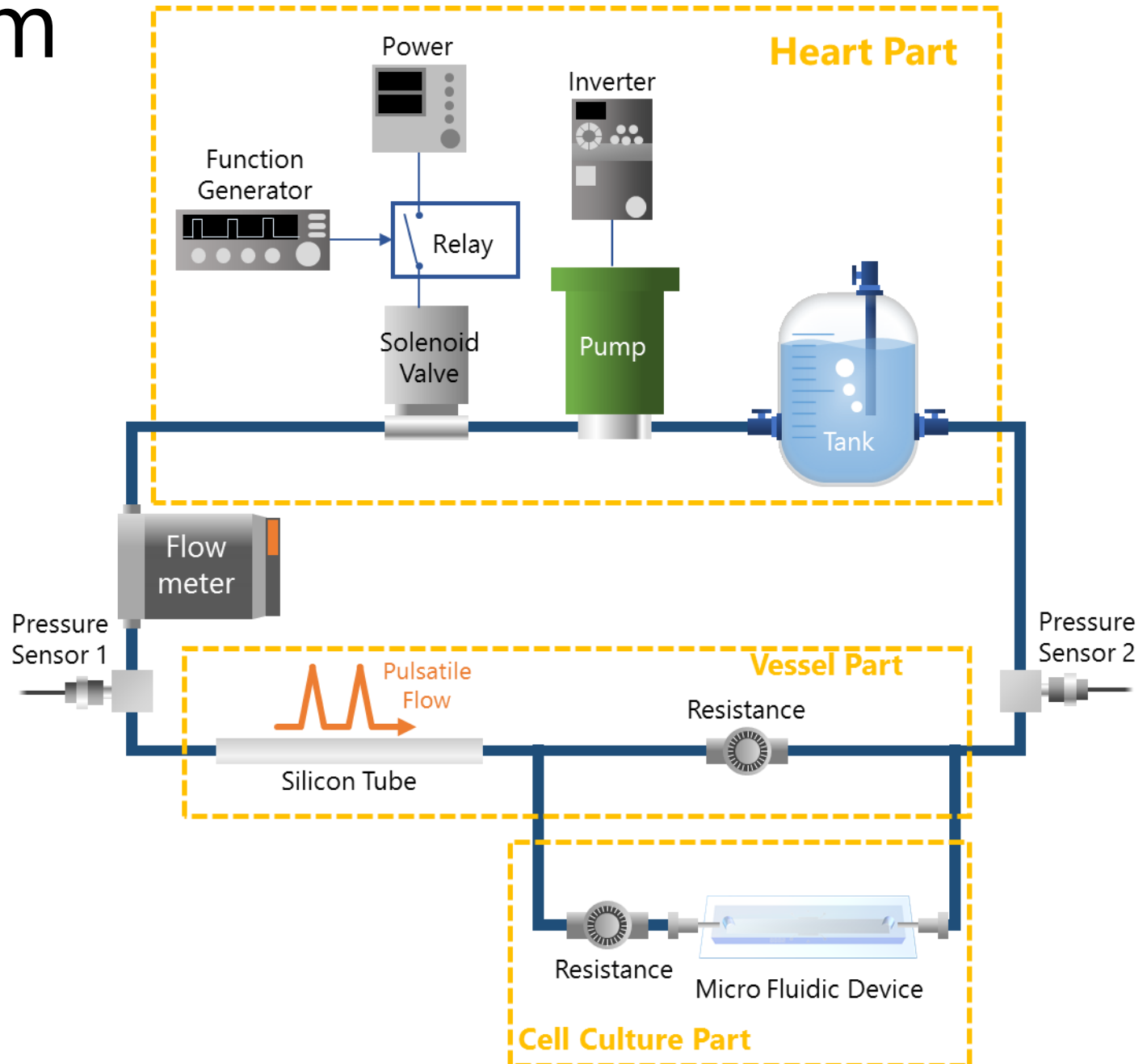


Modification of the pulse simulator

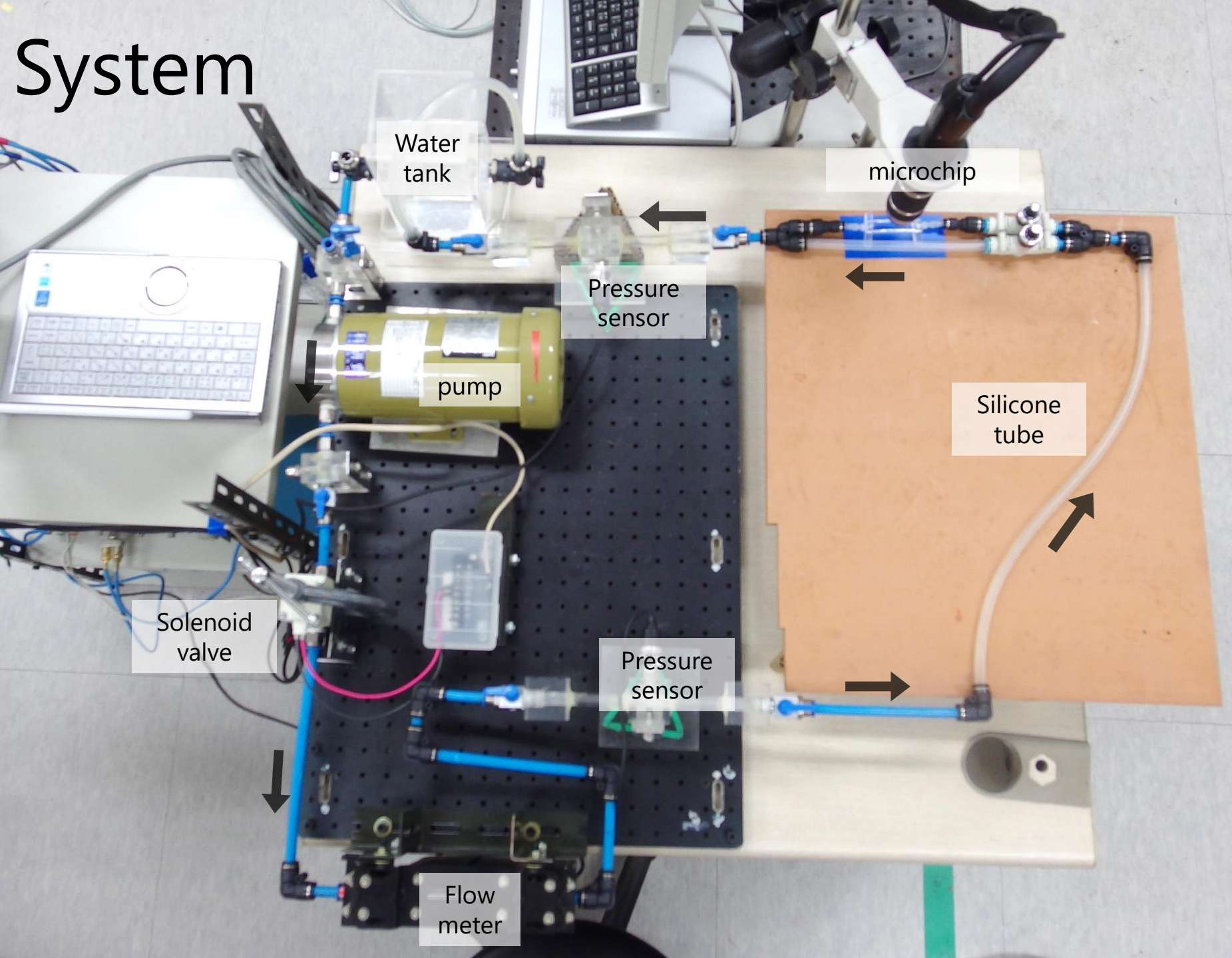


Is it possible to realize pulsation in arterioles?

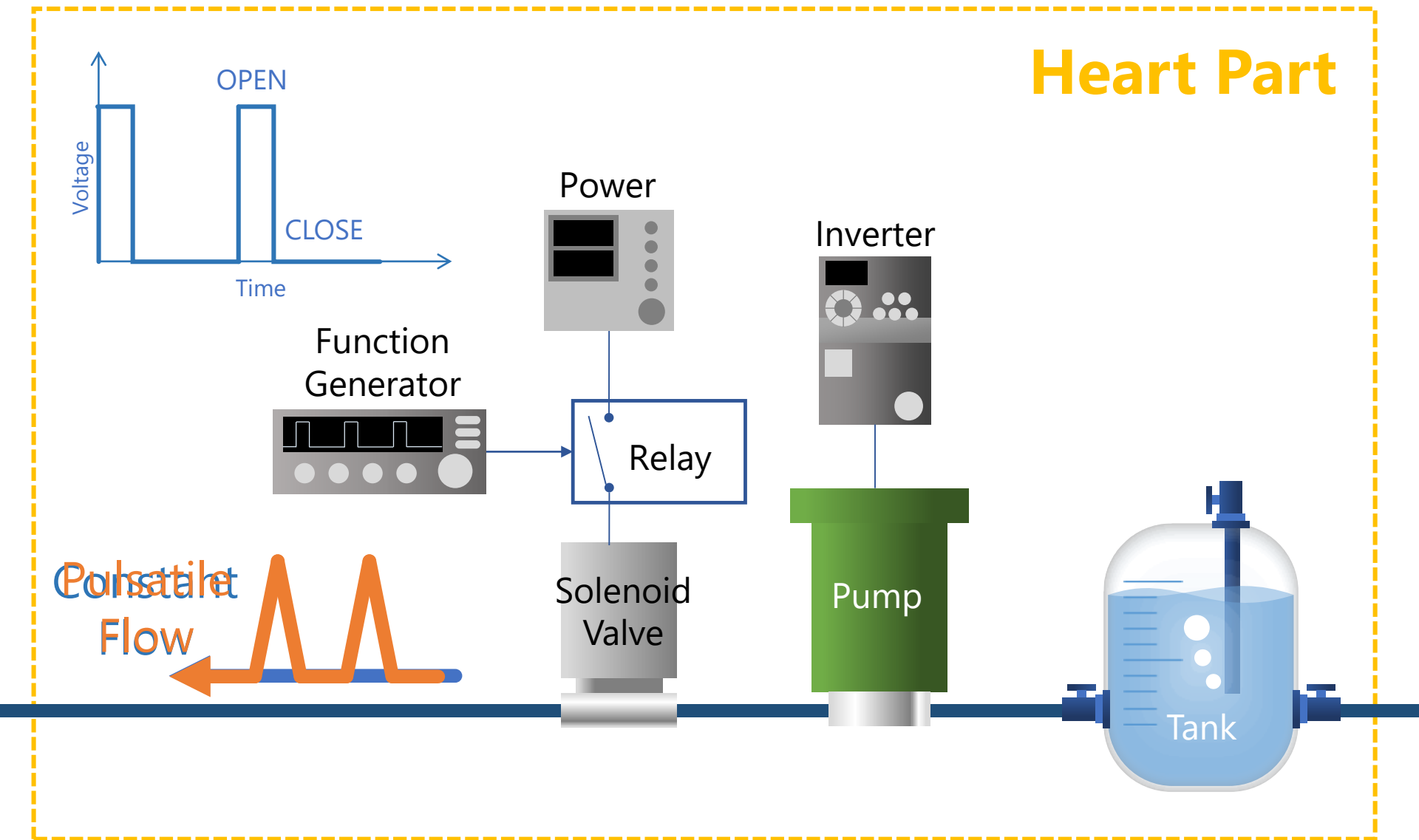
System



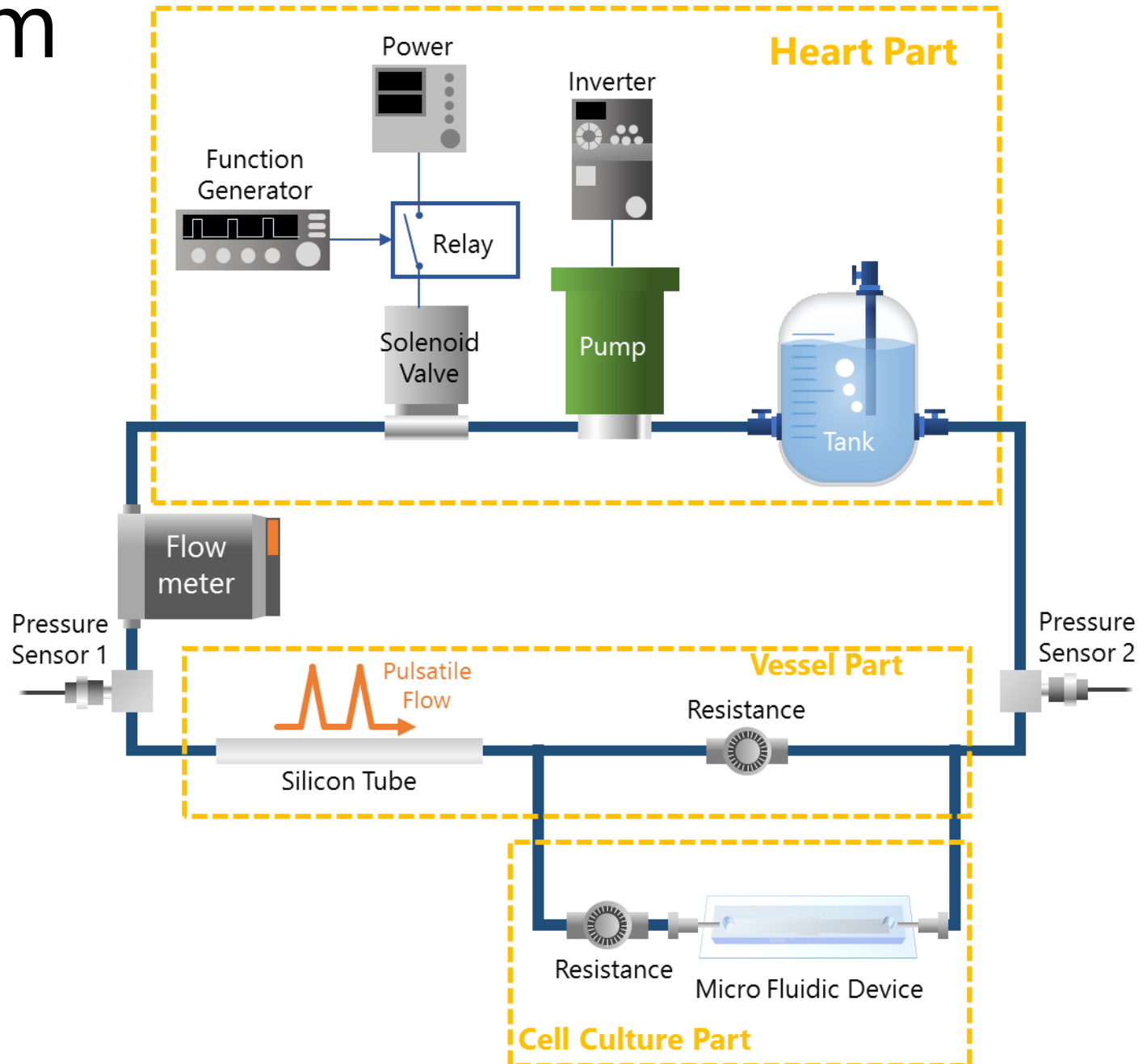
System



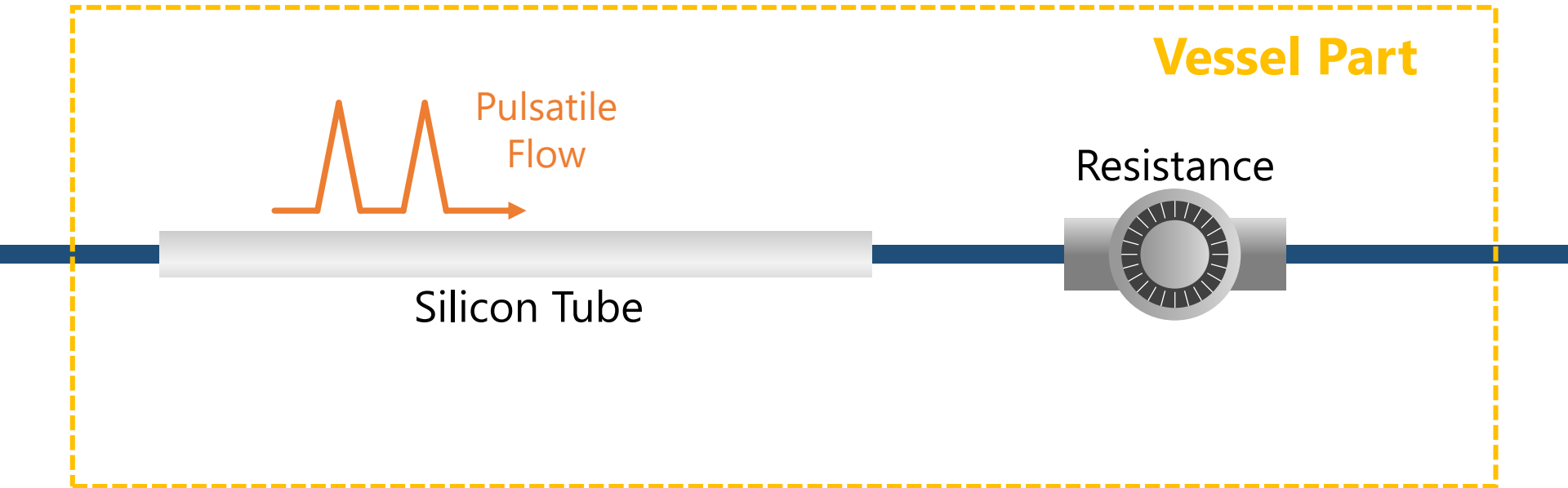
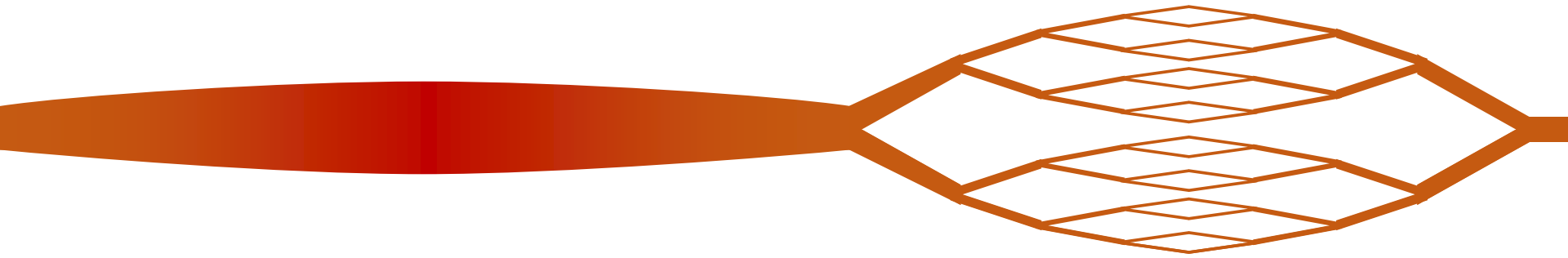
How to realize pulsation?



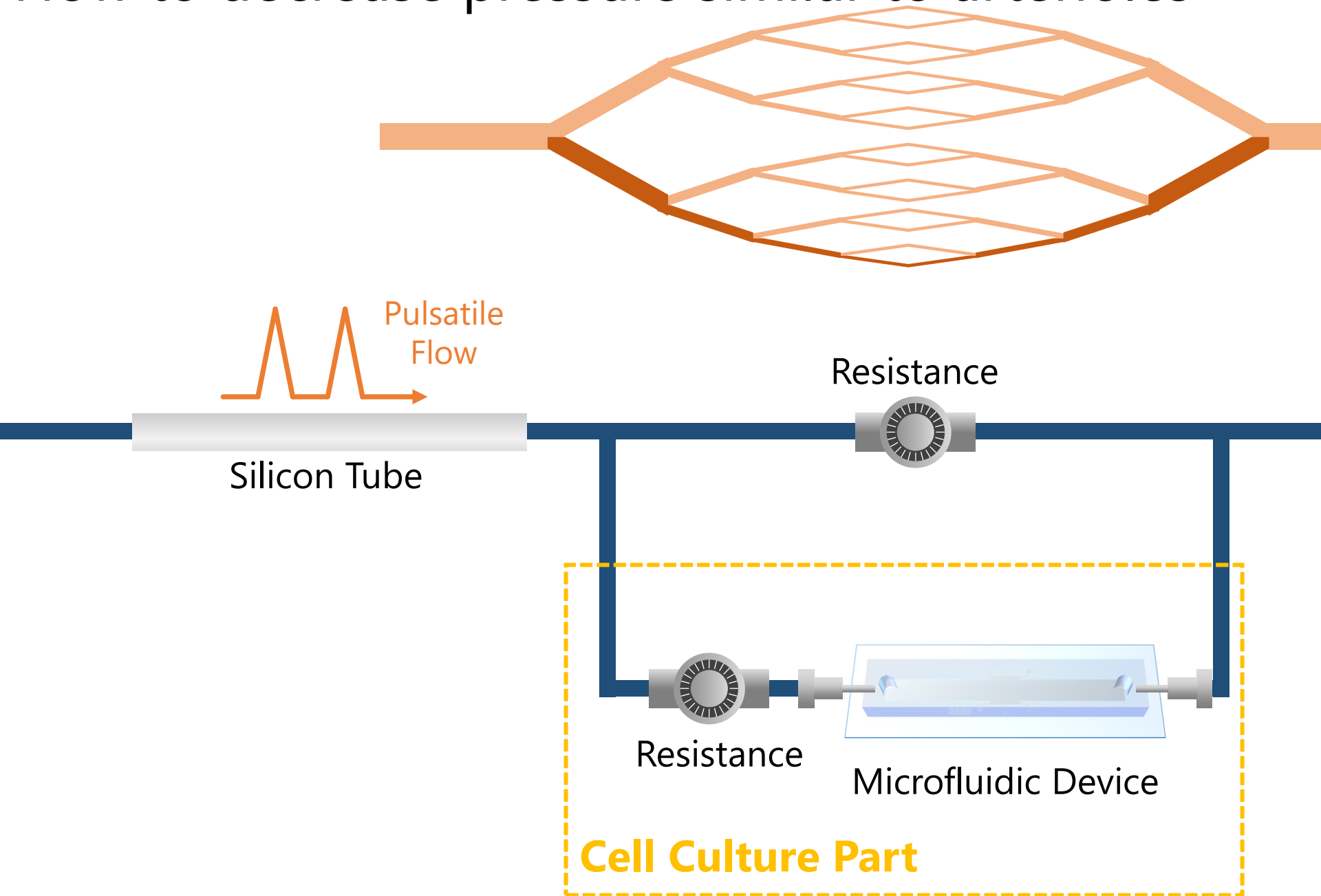
System



How to decrease pressure similar to arterioles

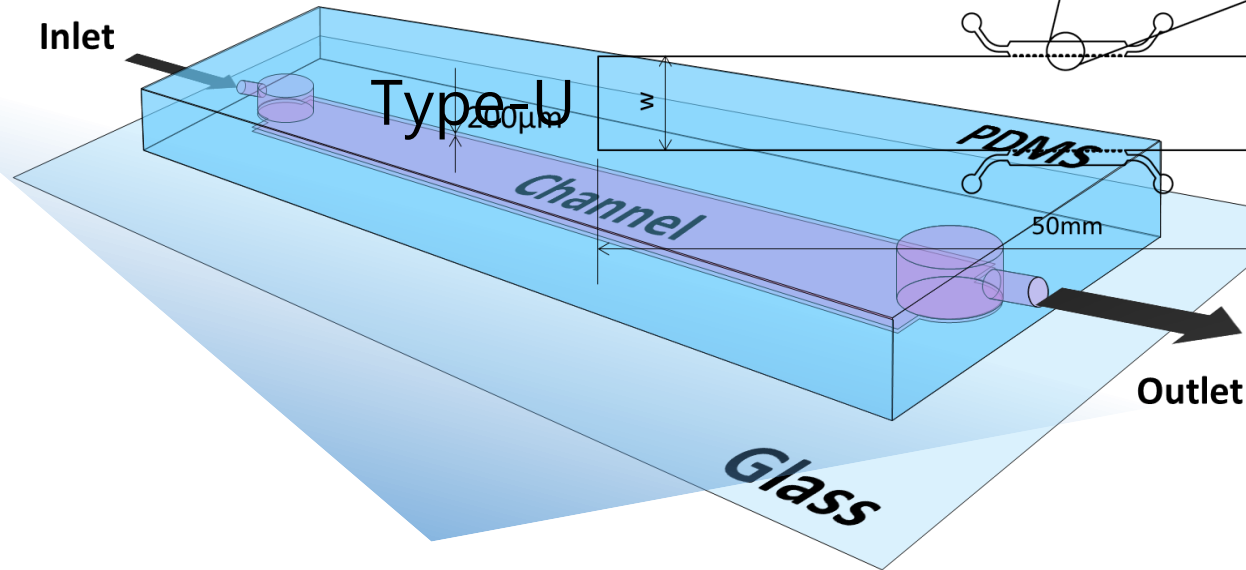
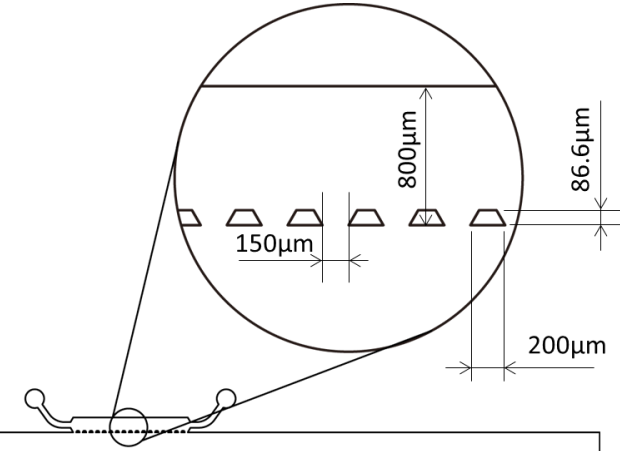


How to decrease pressure similar to arterioles

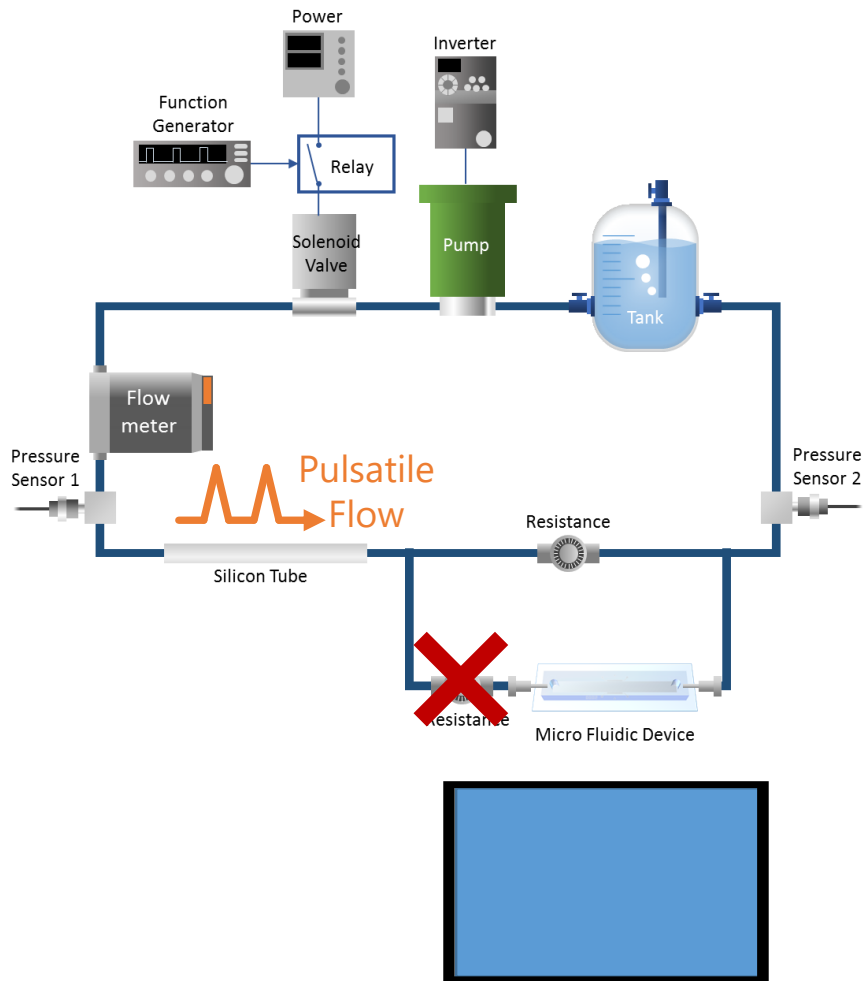


Design of microfluidic devices

Type-S

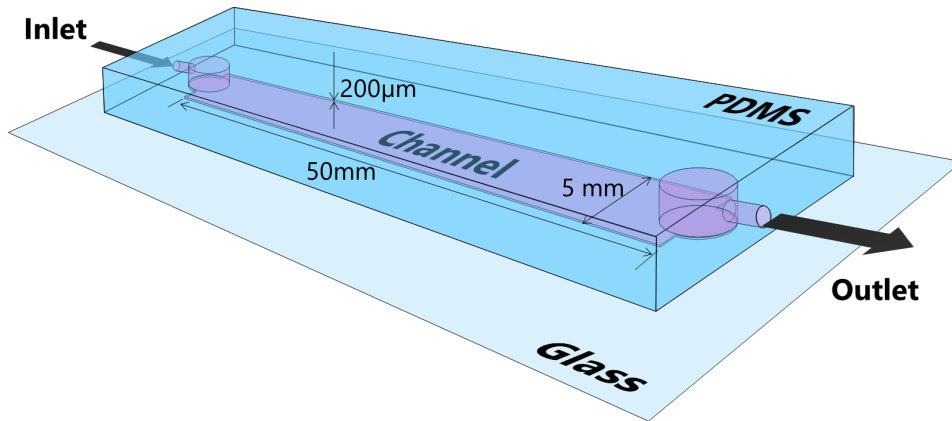


Experimental

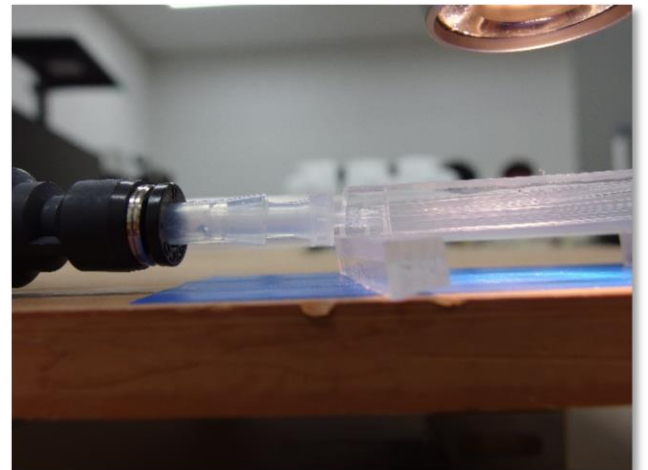
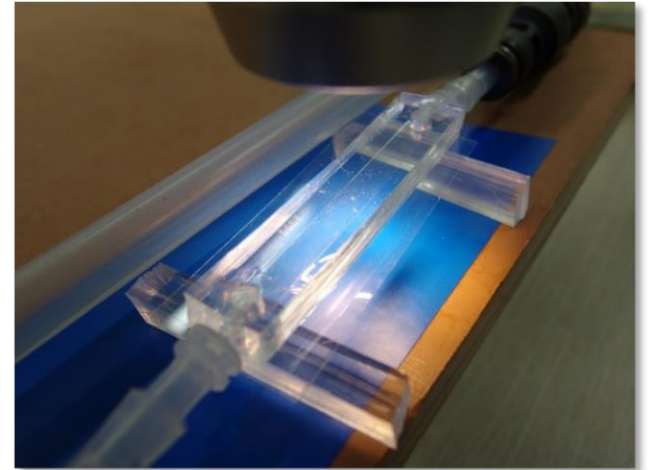
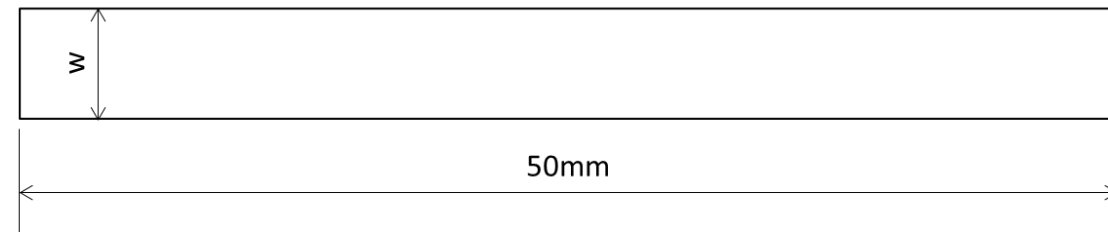


1. Close the valve of microfluidic a device
2. Pulse-pressure control
3. Flow particles in a microchannel
4. Open the valve of microfluidic a device (Max 16.0)
5. Inspection using a microscope
6. Flow rate measurement

Connection



Type-S $w=5\text{ mm}$



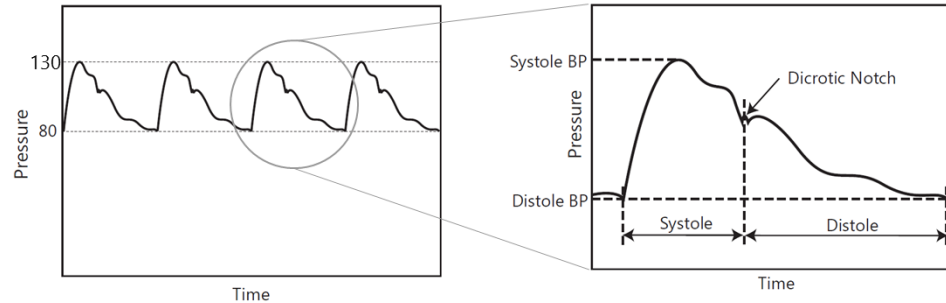
Pulse-pressure measurement

Health man

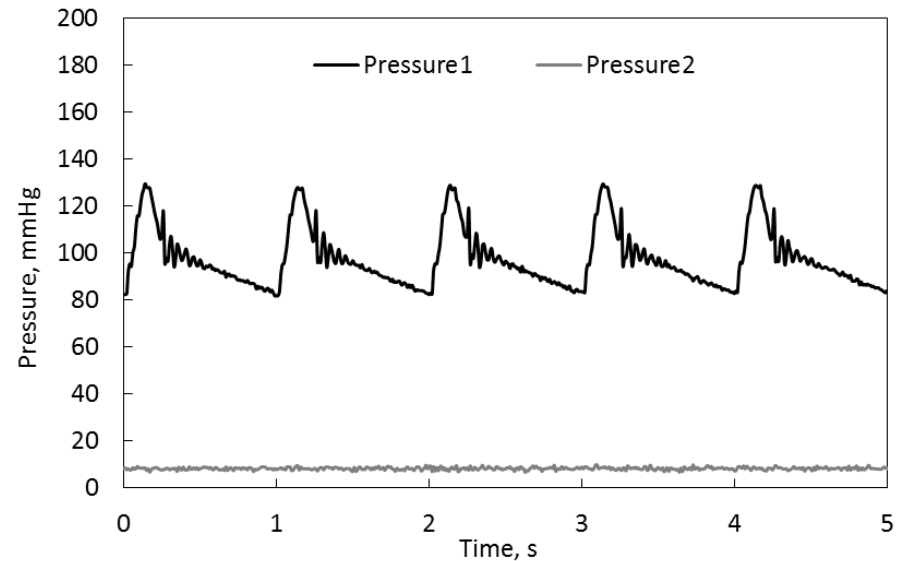
Max **130** mmHg

Min **80** mmHg

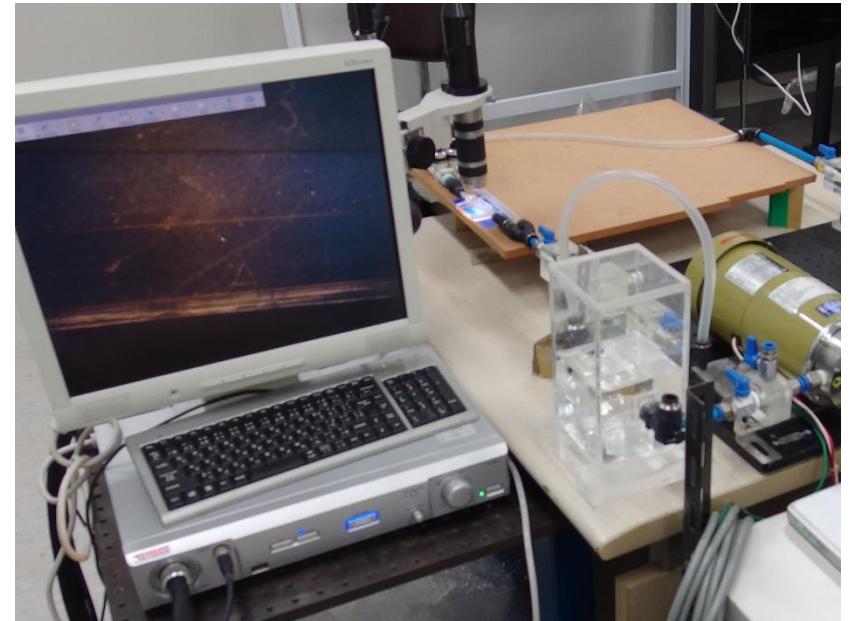
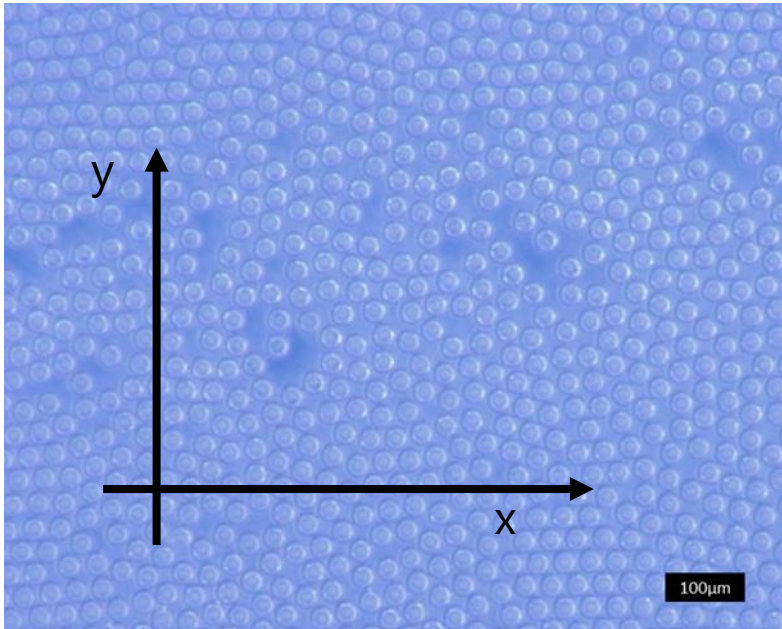
1.0 Hz



**Measured
pulsation**



Measurement of flow rates



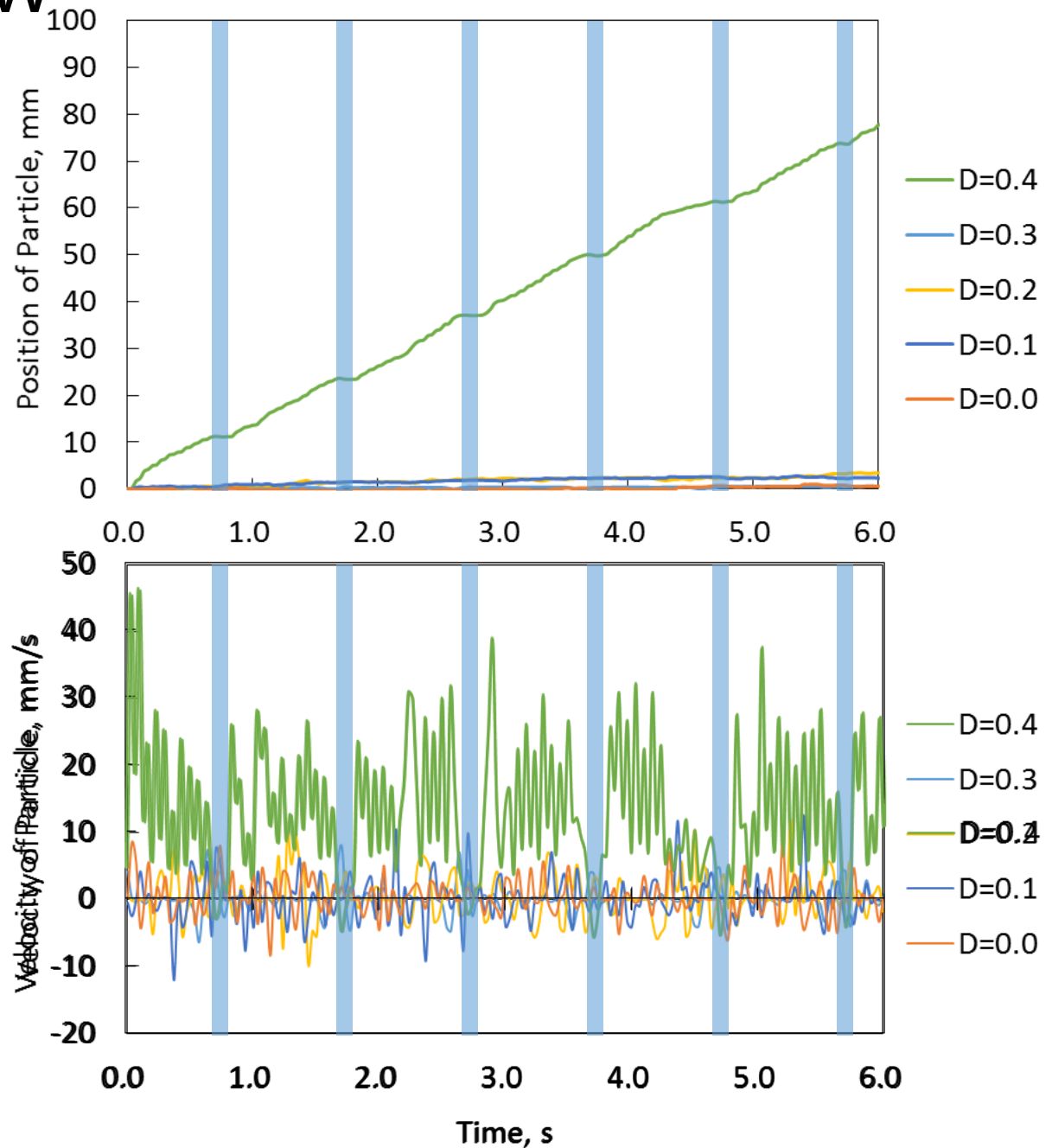
$\Phi 30\mu\text{m}$ particles

Measured flow rates

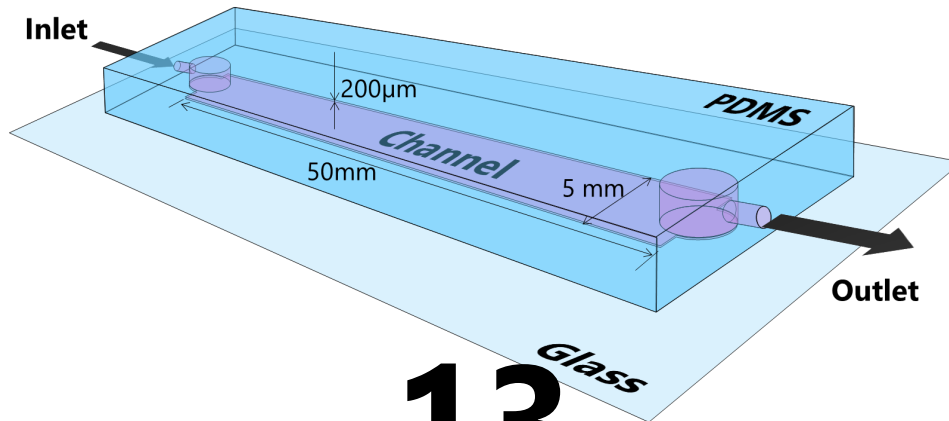
Position



Velocity



Measured flow rates



average **13** mm/s



average **15** mm/s

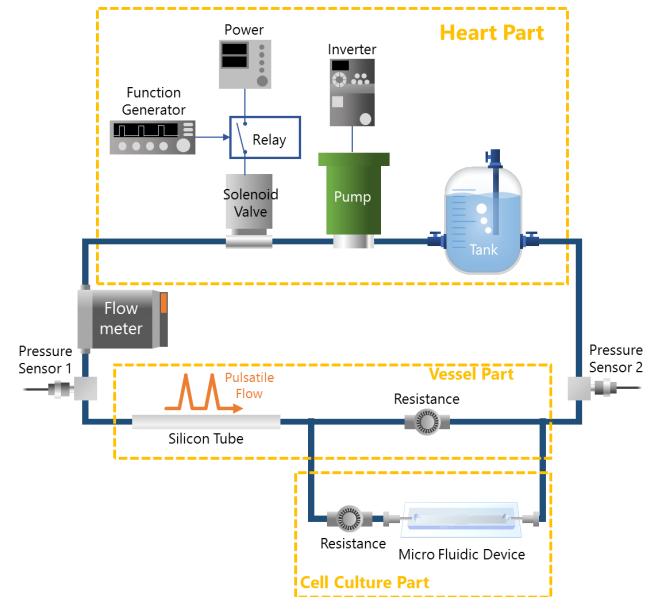
Viscosity of blood is **4.5** times higher than viscosity of water

Low shear stress

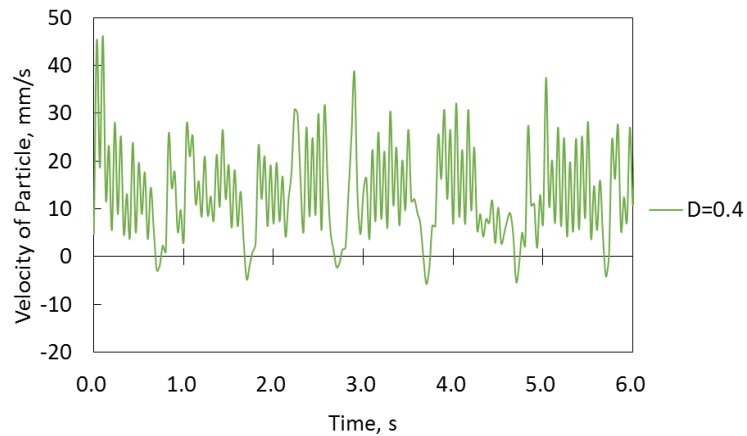
If we control flow rates, we can realize shear stress of arterioles in our system.

Conclusion

Modification of a pulse simulator



Realization of pulse pressure in a microfluidic device



If we culture blood-vessel cells in a microfluidic device, we can study vascular mechanobiology.

Acknowledgement

