Advanced Technologies
for
Cell and Tissue Culture

People @POLIMI
Monica Soncini
Gianfranco Beniamino Fiore
Lorenzo Coppadoro
Elia Pederzani
Alessandra Rando

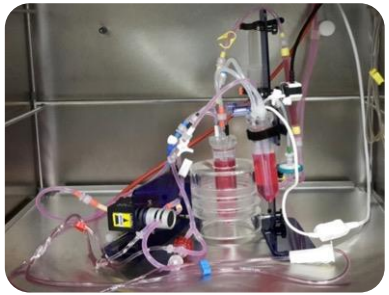
ATTiC Lab
Advanced Technologies for tissue and cell culture Lab

Contact: Monica Soncini
Phone number 02 2399 3336
monica.soncini@polimi.it

Adv Tech for tissue culture
Background: bioreactors for native vessels

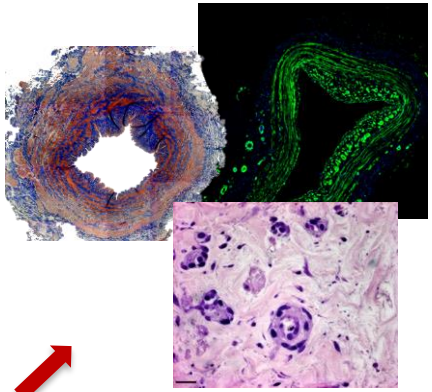
Biomechanics

pulsatile flow and pressure stimulation CPD



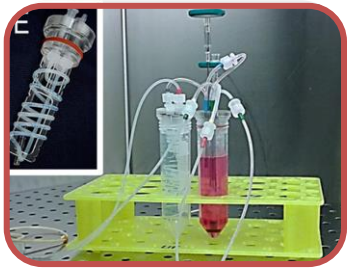
Piola et al, *JTERM*,2013
Prandi, Piola et al., PlosOne, 2015
Piola et al., *Ann of Biomed Eng*, 2016

Experimental campaign



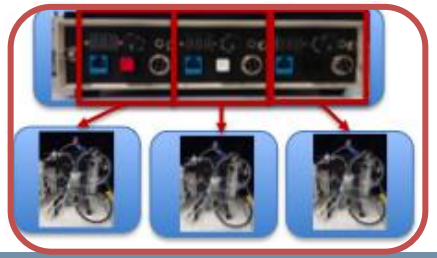
Oxygen levels

Bicompartmental devices



Piola et al., *Ann Biomed Eng*, 2015

Modularity/compactn



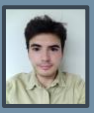
Devices for the operating rooms

In collaboration with

Centro Cardiologico Monzino
Maurizio Pesce, Marco Agrifoglio

Adv Tech for tissue culture

Bioreactors for complex hydrodynamic stimulation



elia.pederzani@polimi.it

Characteristics

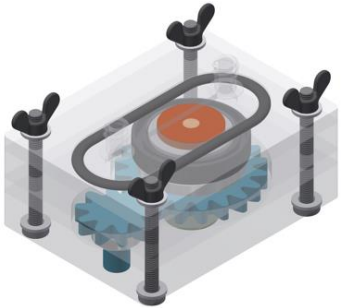
*- Controlled **hydroynamic multidirectional stimulation** for studying vascular endothelial disfunctions*

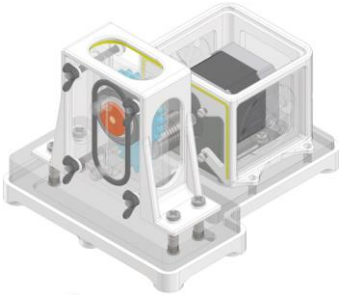
- Modular and versatile, integrated with an electronic control unit

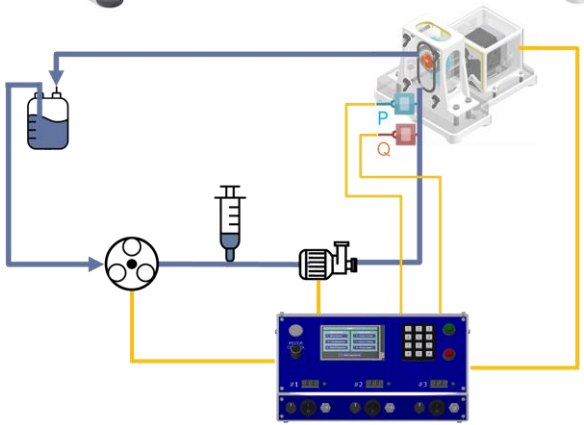
Aims

*- TECH: **hardware** che **software** optimization*

*- BIO: **biological validation** on **cell monolayers** and **biological tissue samples***





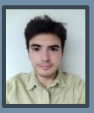


In collaboration with

OSPEDALE SAN RAFFAELE

Adv Tech for tissue culture

Bioreactors for complex hydrodynamic stimulation



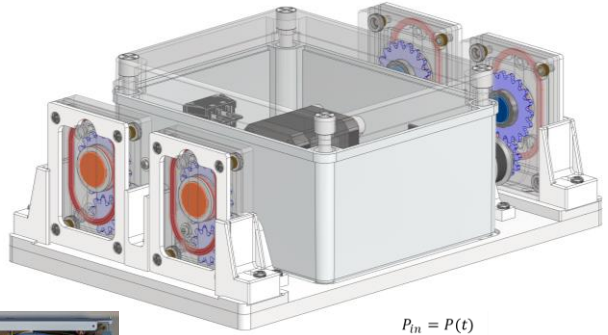
elia.pederzani@polimi.it

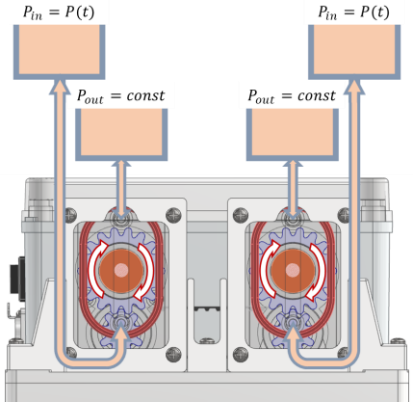
Characteristics

*- Controlled **hydrodynamic multidirectional stimulation** for studying vascular endothelial disfunctions*

- Modular and versatile, integrated with an electronic control unit

- Integration with pressure-driven actuation enabling pressure gradients





Aims

*- TECH: **hardware** and **software** optimization*

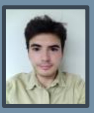
*- BIO: **biological validation** on **cell monolayers***

In collaboration with

Imperial College London

Adv Tech for tissue culture

Bioreactors for recapitulating in vitro vascular graft implantation



elia.pederzani@polimi.it

Characteristics

- Advanced culture system mimicking physiological (and pathological) vascular ***pulsatile conditions***

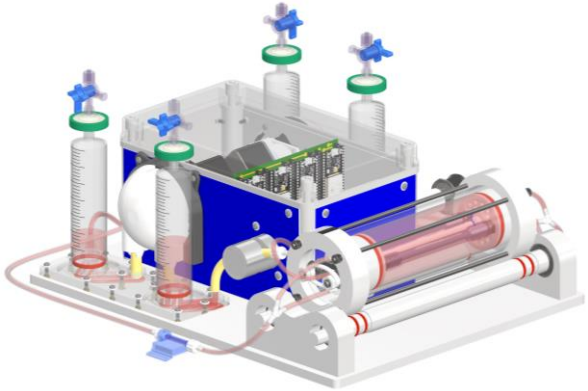
- ***Seeding protocols*** *for endothelialization*

- ***Multipurpose chambers***

Aims

- TECH: ***hardware*** *and* ***software*** *optimization*

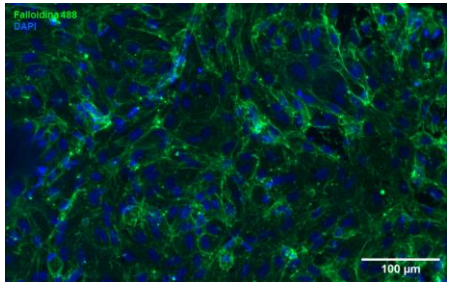
- BIO: ***biological validation*** *for the endothelialization and conditioning of vascular grafts*

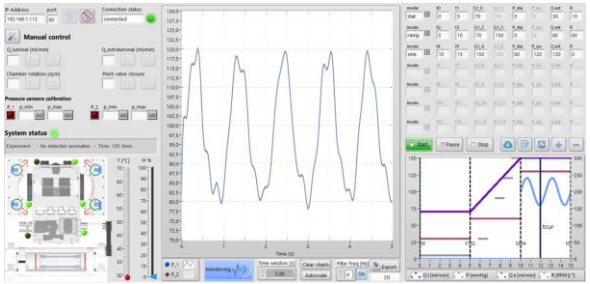


In collaboration with

ISTITUTO DI RICERCHE FARMACOLOGICHE MARIO NEGRI · IRCCS

DIALYBRID





Adv Tech for tissue culture

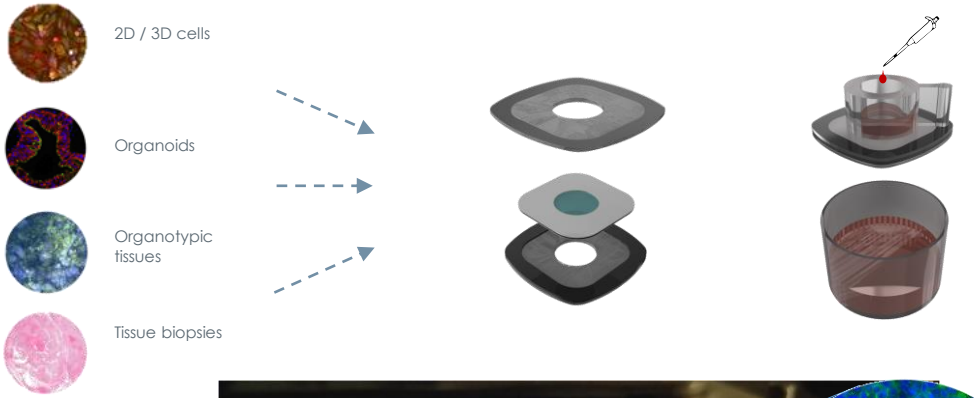
TTOP: True Tissue on plate platform (tissue-organ on chip)

In vitro models of tissue barriers

TTOP
COMPLEX CONDITIONS SIMPLE CONTROL

Characteristics

- *optical accessibility*
- *contact co-culture*
- *easy to use*
- *versatility of the biological sample*
- *sample retrieval and reuse in different platforms*



Awards

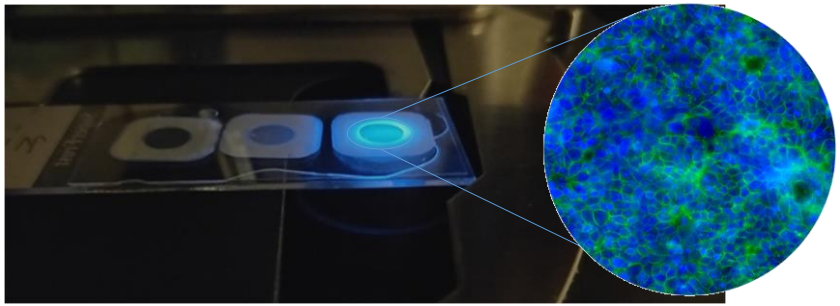
S2P 2020

STARTCUP LOMBARDIA 2021

Pre seed grant POLI360

Innostar Award 2022

Bocconi for innovation 2023



lorenzopietro.coppadoro@polimi.it

Adv Tech for tissue culture

TTOP: True Tissue on plate platform (tissue-organ on chip)

In vitro models of tissue barriers

TTOP
COMPLEX CONDITIONS SIMPLE CONTROL

Characteristics

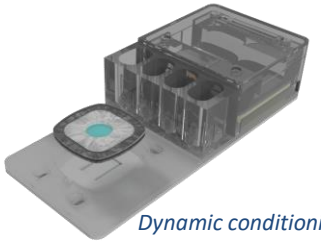
- ***Modular and versatile*** *platform* ***for tissue barriers***
- *Towards an* ***automated platform***

Aims

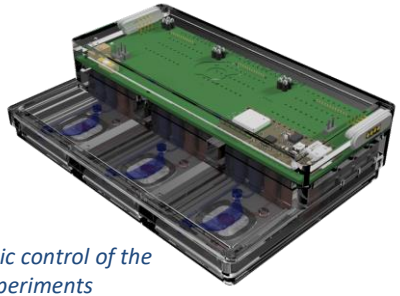
- *TECH* ***control System optimization***
- *TECH* ***biosensor integration*** *for monitoring cell growth and functions*
- *BIO* ***biological validation*** *of the dynamic platform*

Cartridge Assembling

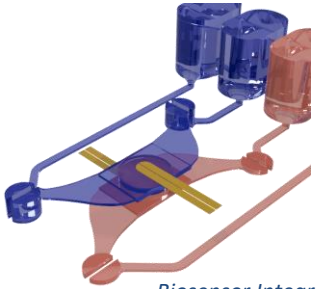
Static culture preparation



Dynamic conditioning



Automatic control of the experiments



Biosensor Integration

lorenzopietro.coppadoro@polimi.it

Adv Tech for tissue culture

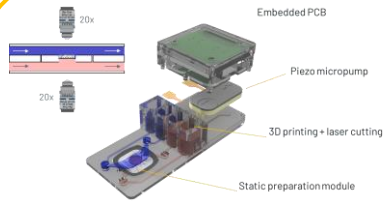
TTOP: True Tissue on plate platform (tissue-organ on chip)

In vitro models of tissue barriers

lorenzopietro.coppadoro@polimi.it

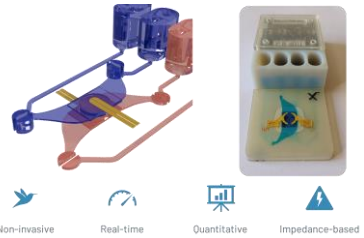
TECH development – main activities

Dynamic system setting
Control system optimization

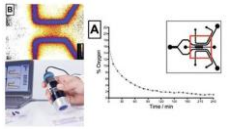


biosensor integration
for monitoring cell growth/functions

TEER / Impedance

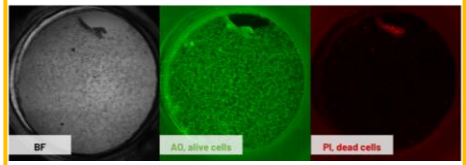


Oxygen



biological validation *of the dynamic platform*

Under flow culture of endothelial/epithelial cells



Adv Tech for tissue culture

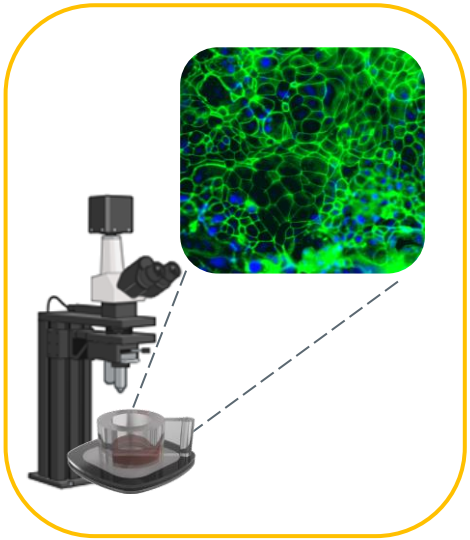
TTOP: True Tissue on plate platform (tissue-organ on chip)

In vitro models of tissue barriers

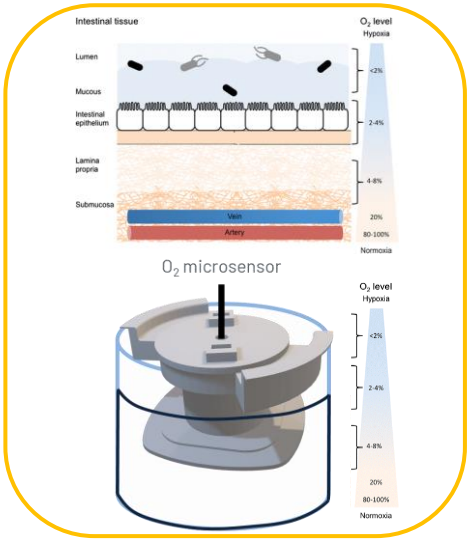
BIO development – main activities

alessandramaria.rando@polimi.it

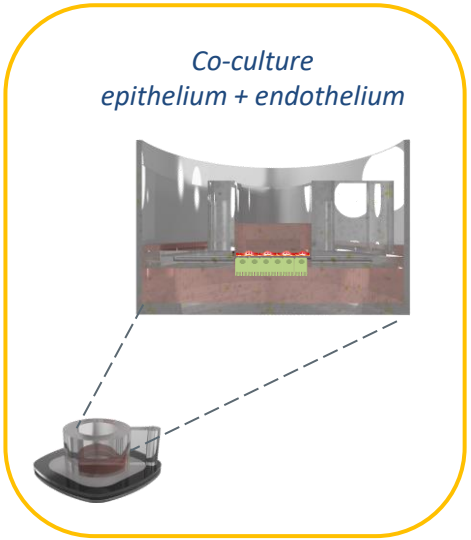
Intestinal epitheluim model with Caco-2



Characterization of O_2 gradients in vitro



gut-vascular barrier in vitro model



Adv Tech for tissue culture

TTOP: True Tissue on plate platform (tissue-organ on chip)

In vitro models of tissue barriers

Development and collaborations

BIO validation of the platform with tissue models available on the market
Ospedale San Raffaele

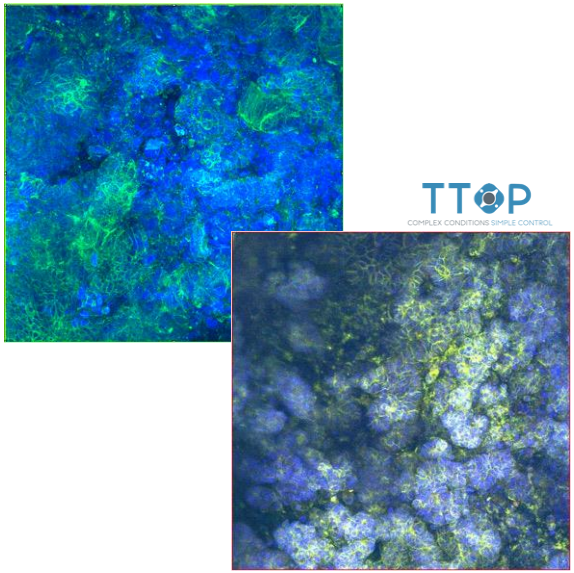
Compatibility with 3D bioprinting and other post-culture equipment for cell/tissue analyses

Modification of the membranes and materials
Marco Cantini, Manuel Salmeron-Sanchez, Glasgow Univ.

TToP used for studying physiopathology and new treatments in cardiovascular field
Centro Cardiologico Monzino

In vitro Lung models in TToP
Politecnico di Torino
Università Milano Bicocca

MATTEK
A BICO COMPANY

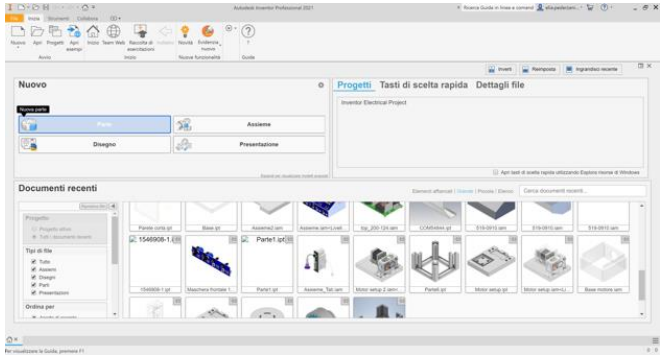


TTOP
COMPLEX CONDITIONS SIMPLE CONTROL

lorenzopietro.coppadoro@polimi.it
alessandramaria.rando@polimi.it

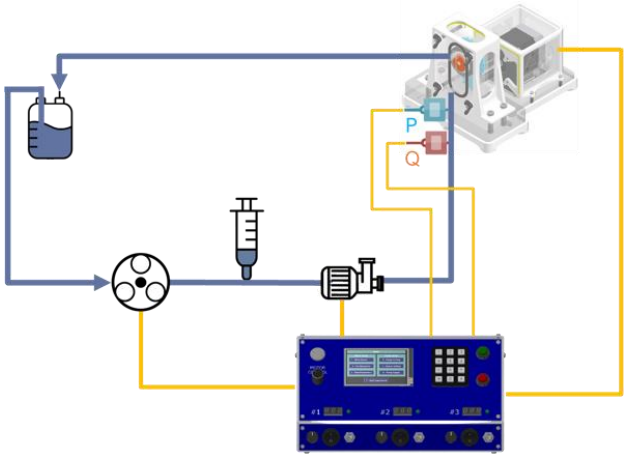
Adv Tech for tissue culture

Work flow and main activities



*1. **Design and prototyping of** culture chambers/components/supports*

- *Design with **CAD** (Inventor)*
- ***simulations***
- ***prototyping** (laser, drilling machine, 3D printing)*



*2. **Design and realization of the hydraulic circuit***

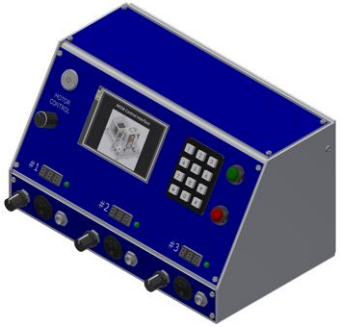
*- Choosing the **actuation components***

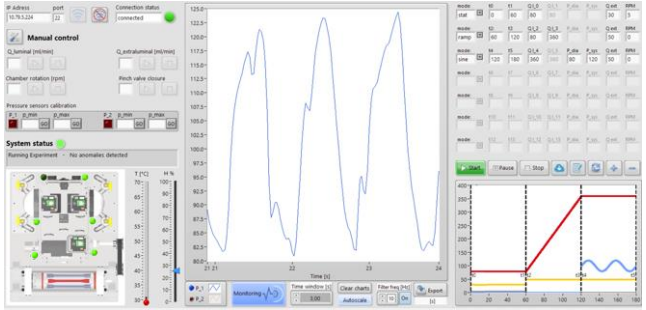
*- Design of the **hydraulic circuit***

*- **Process automations** (seeding, mediun change)*

Adv Tech for tissue culture

Work flow and main activities

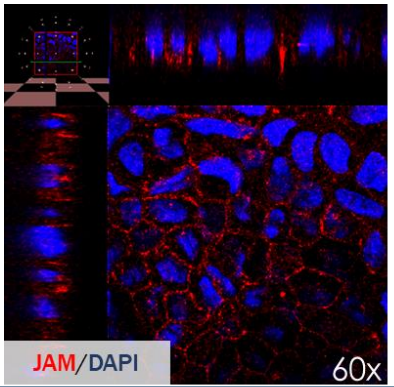




*3. **Control system** development*
- Arduino programming
- Control unit realization

*4. **Bench tests***
- Phantom
- Biological tissues/prototissues

*5. **Experimental campaign**: in vitro model development (**ATTIC Lab**)*
- cell / tissue cultures
- Culture post processing and analyses (hysto, IF):
tissue morphology,
cell density and proliferation,
cell / tissue characterization



Adv Tech for tissue culture

Involved Labs

- **Advanced Technologies for Tissue Culture - ATTiC Lab**
- **Rapid Prototyping Lab**
- **Experimental Micro e Bio-fluid dynamics Lab**

People

M. Soncini

E. Pederzani, Post-doc

A. Rando, PhD student

G.B Fiore

L. Coppadoro, Researcher

Adv Tech for tissue culture

Involved Labs