Microfluidica si Dinamica Biofluidelor – domenii noi de cercetare la Universitatea Politehnica din Bucuresti.

Corneliu Balan & REOROM Group

"Politehnica" University of Bucharest
DBB - REOROM Laboratory

Grant CNCSIS 184

Director: dr. ing. CORNELIU BALAN

APPLICATION OF FLUIDS RHEOLOGY IN BIOLOGY AND MEDICINE

2000

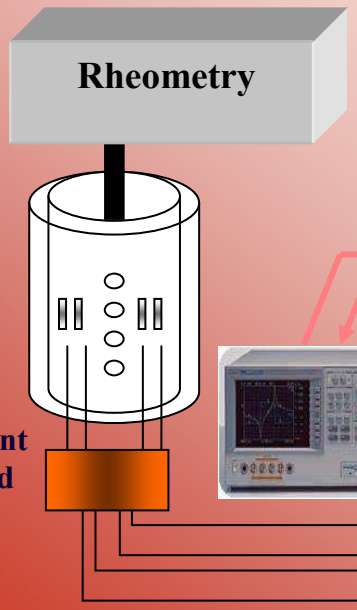
Project coordinator:

REOROM GROUP – "Politehnica" University of Bucharest
LABORATORY OF FLOW VISUALISATIONS AND FLUIDS MODELING
Member of THE NATIONAL CENTER OF SYSTEMS ENGINEERING WITH COMPLEX FLUIDS
"Politehnica" University of Timisoara

Partners:

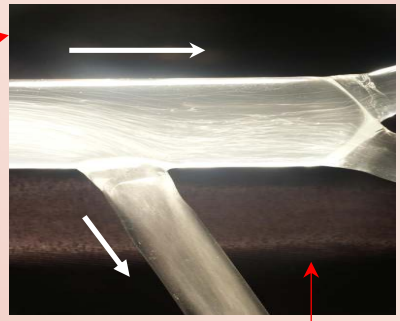
CLINIC "FUNDENI" HOSPITAL
INTERNATIONAL CENTER OF BIODYNAMICS

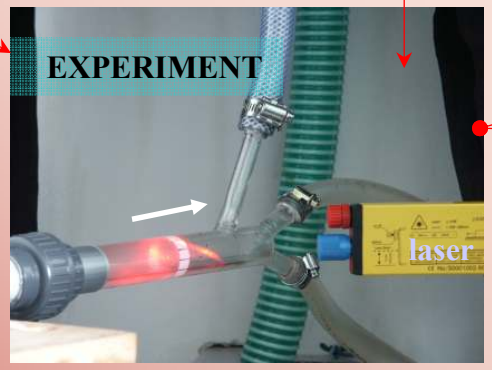
AIM: **Modeling and investigations of blood flow in bifurcations; applications – correlation of flow regime in portal vein to the liver malfunction**



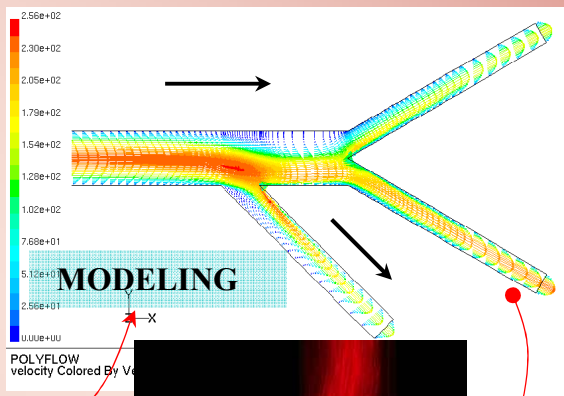
ORIENTATION OF RED CELLS IN FLOW

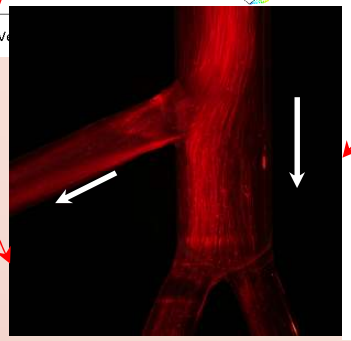
FUNDAMENTAL RESEARCH





FLOW VISUALISATIONS



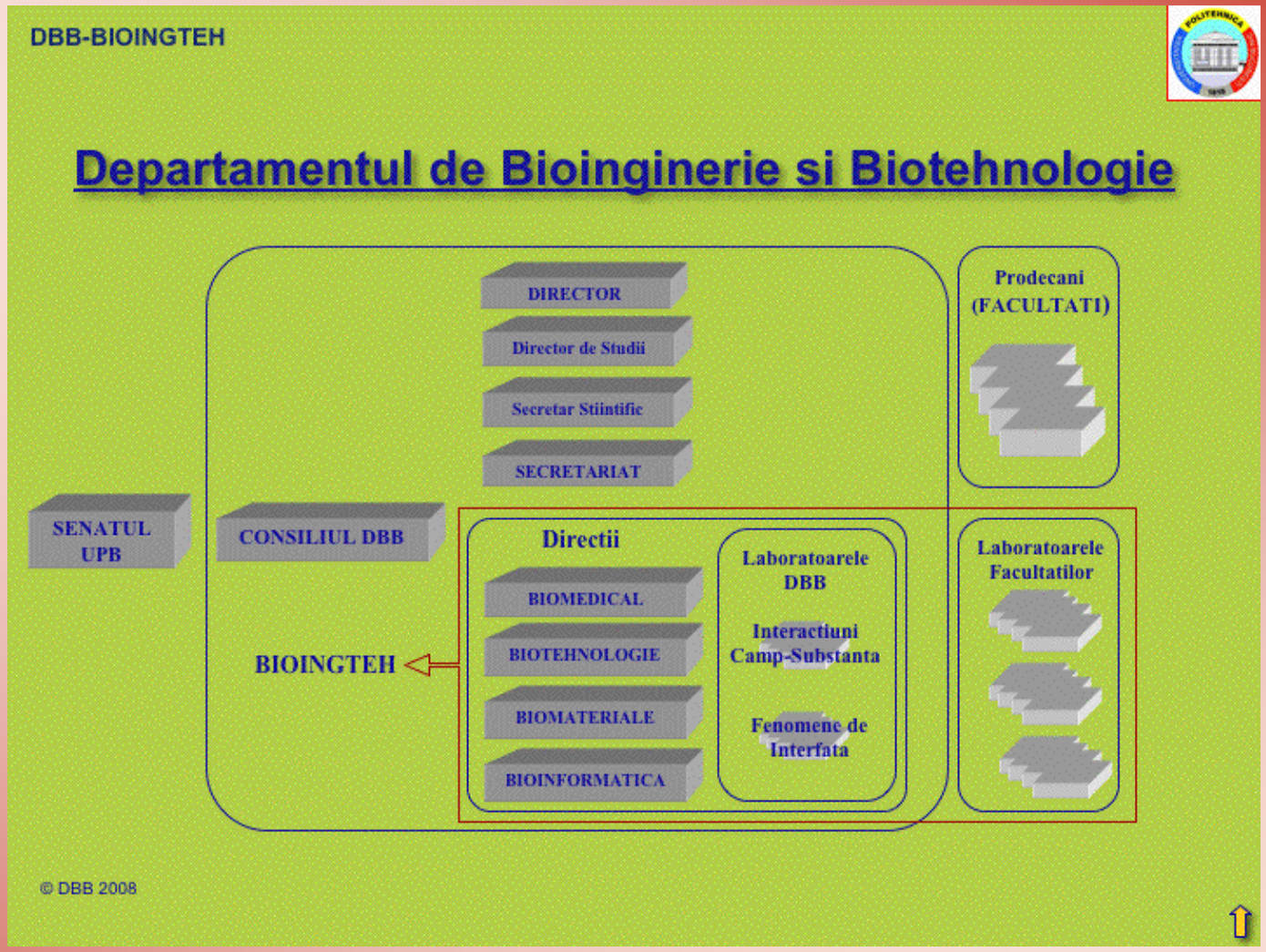


NUMERICAL INVESTIGATIONS

since 2002

WWW.DBB.PUB.RO

Director: Prof. dr. ing. Alexandru Morega

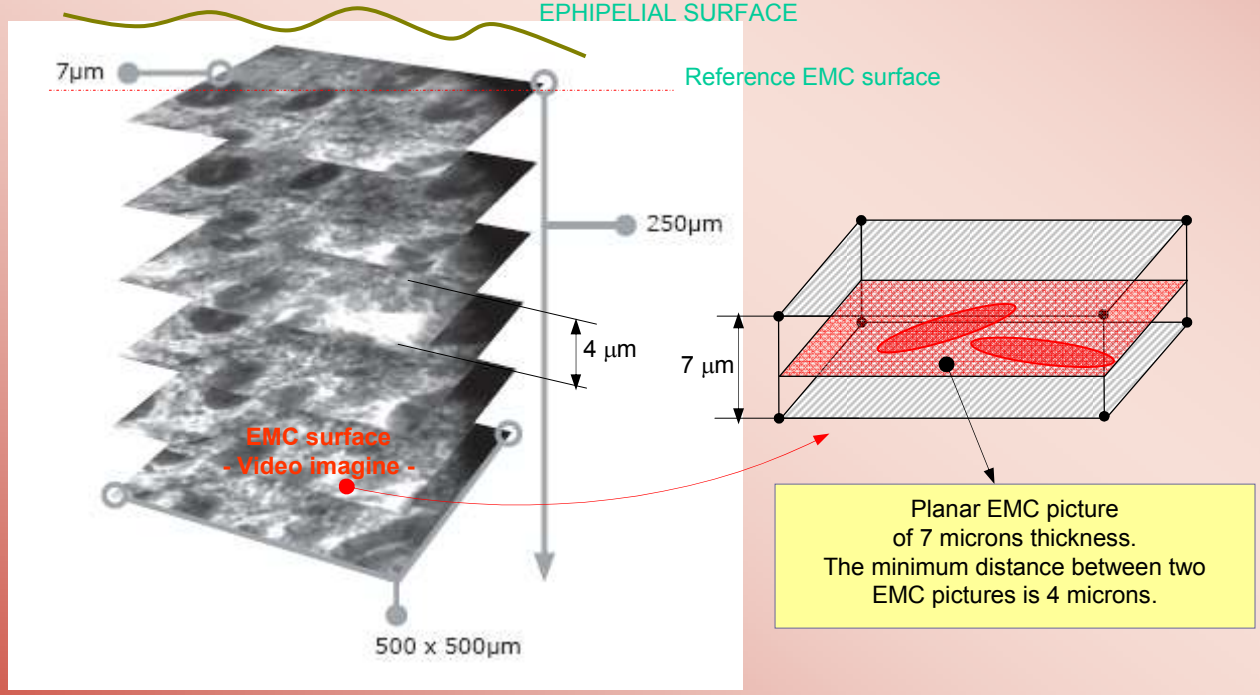


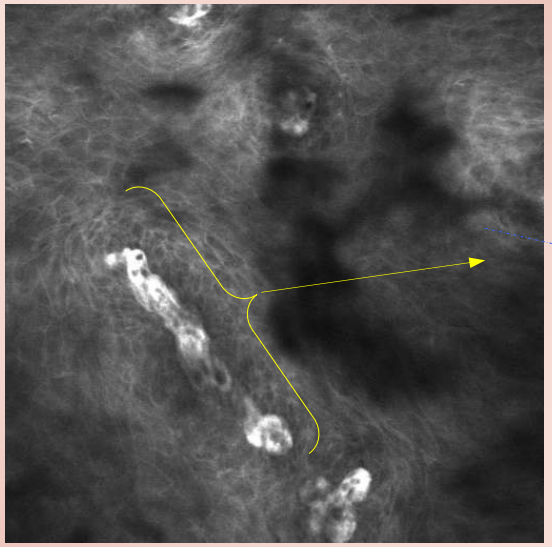
BIOINGTEH - Exploratory Workshop (CNCSIS)
Advanced Materials & Technologies in Biology and Medicine
18 – 20 September 2008, Poiana Braşov, Romania

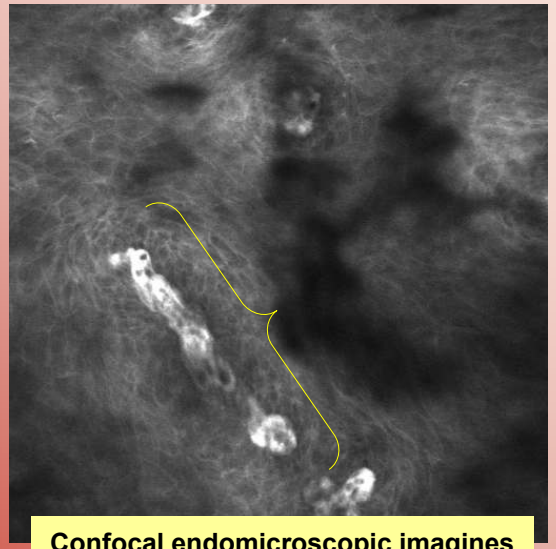
Visualization – Modeling – Experiment – Simulations

MICRO-CHANNELS HYDRODYNAMICS

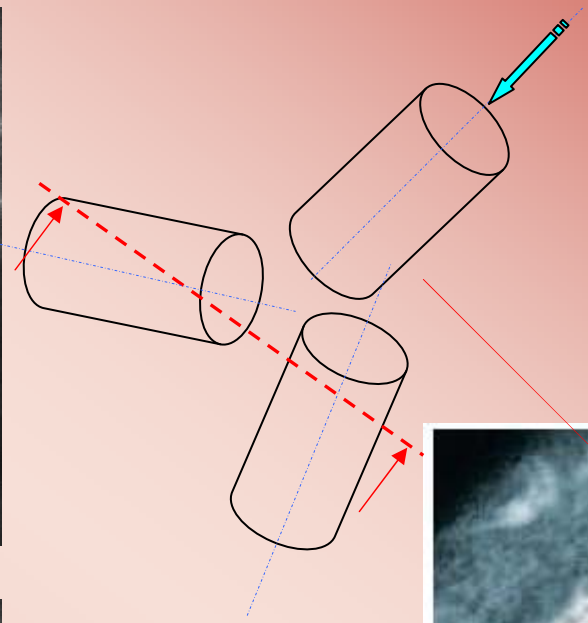
CONFOCAL ENDOMICROSCOPY - EMC



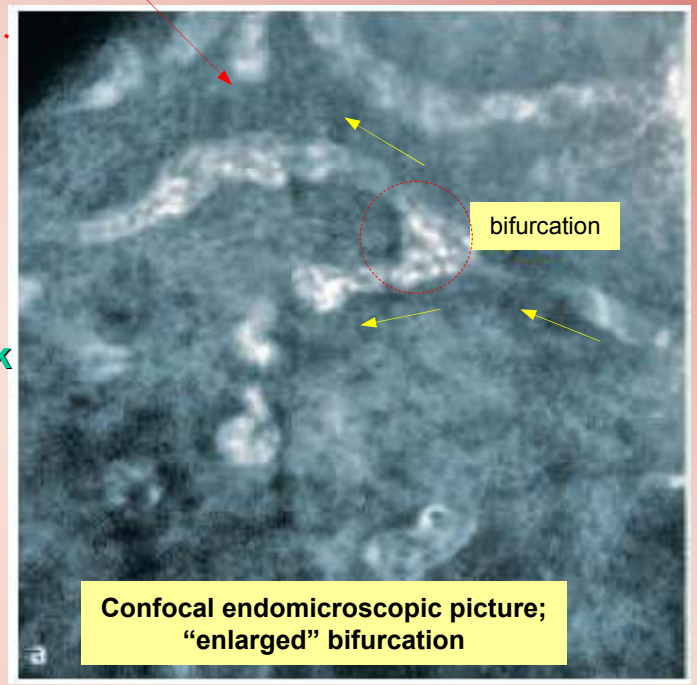




Confocal endomicroscopic imagines
"Fundeni" Clinical Hospital



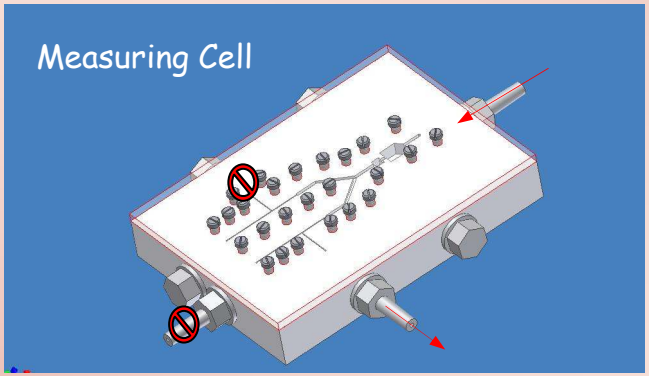
Digital reconstruction
of the capillary network

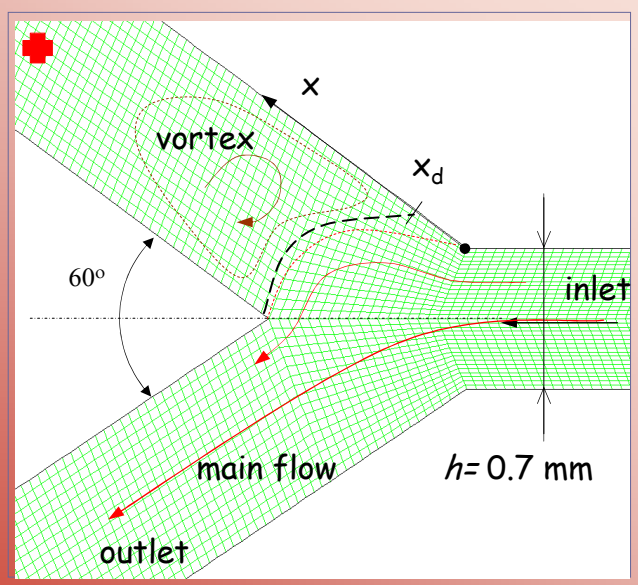


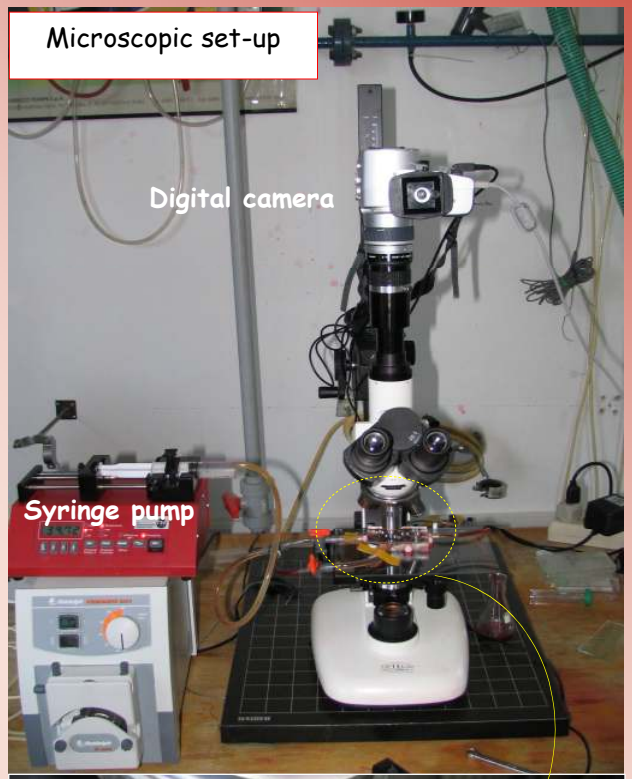
Confocal endomicroscopic picture;
"enlarged" bifurcation

Micro-geometry – Micro-channels

Micro-channels hydrodynamics

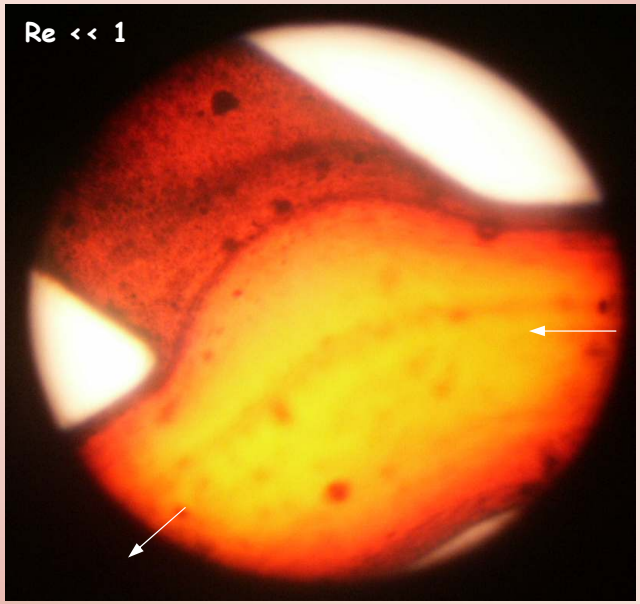


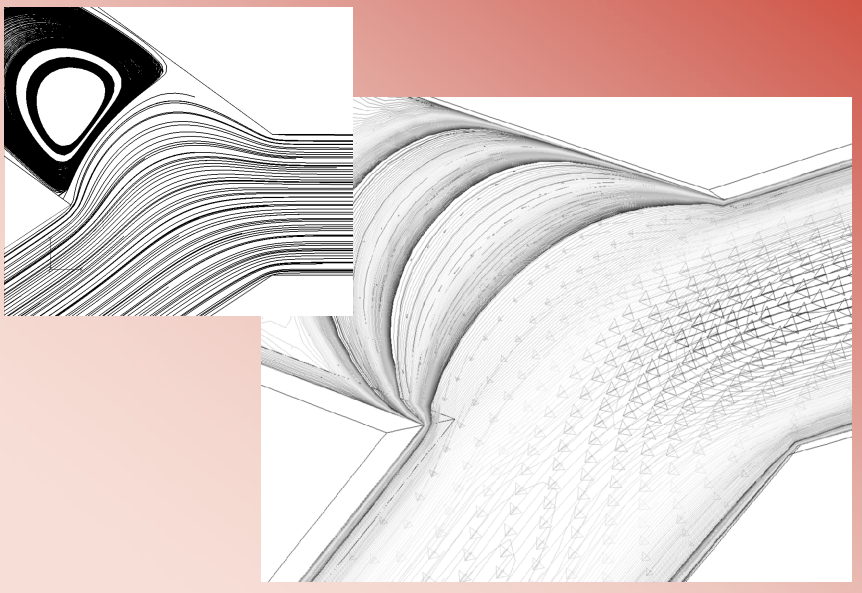


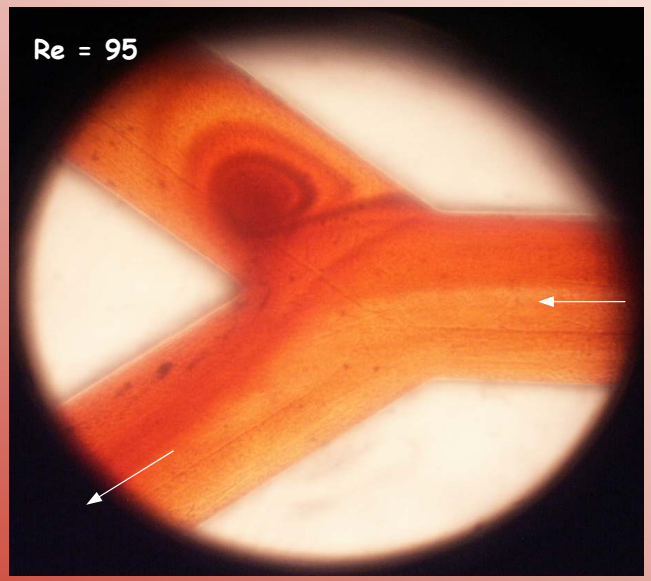


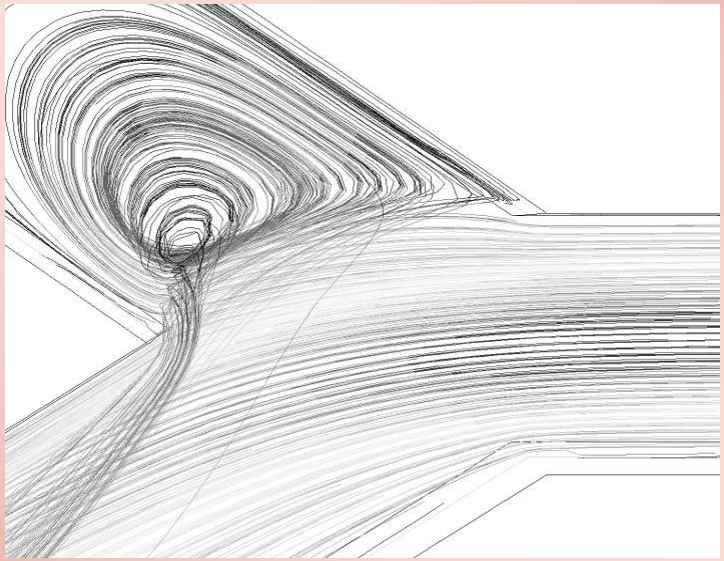
Experiments

Numerical simulations

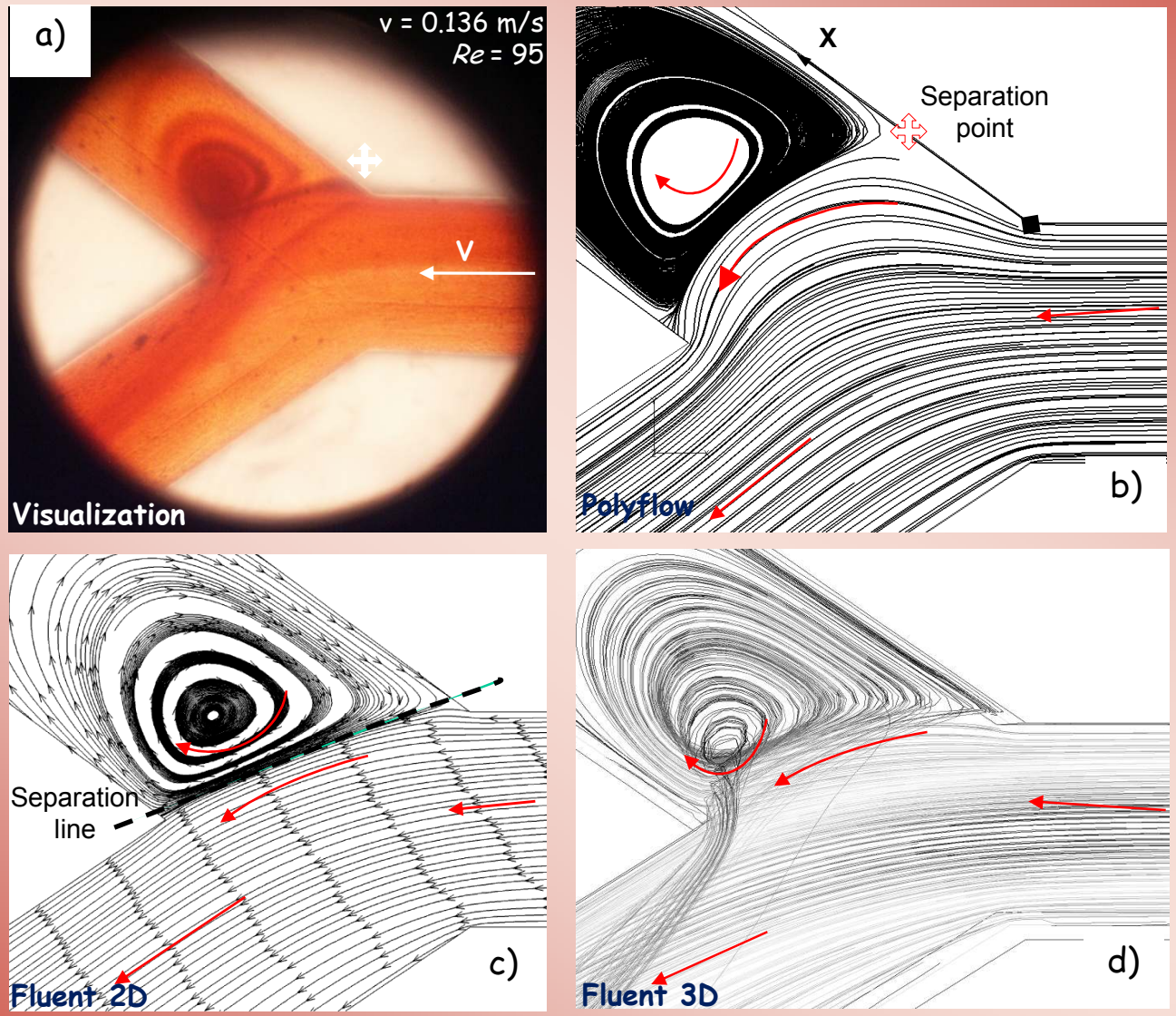




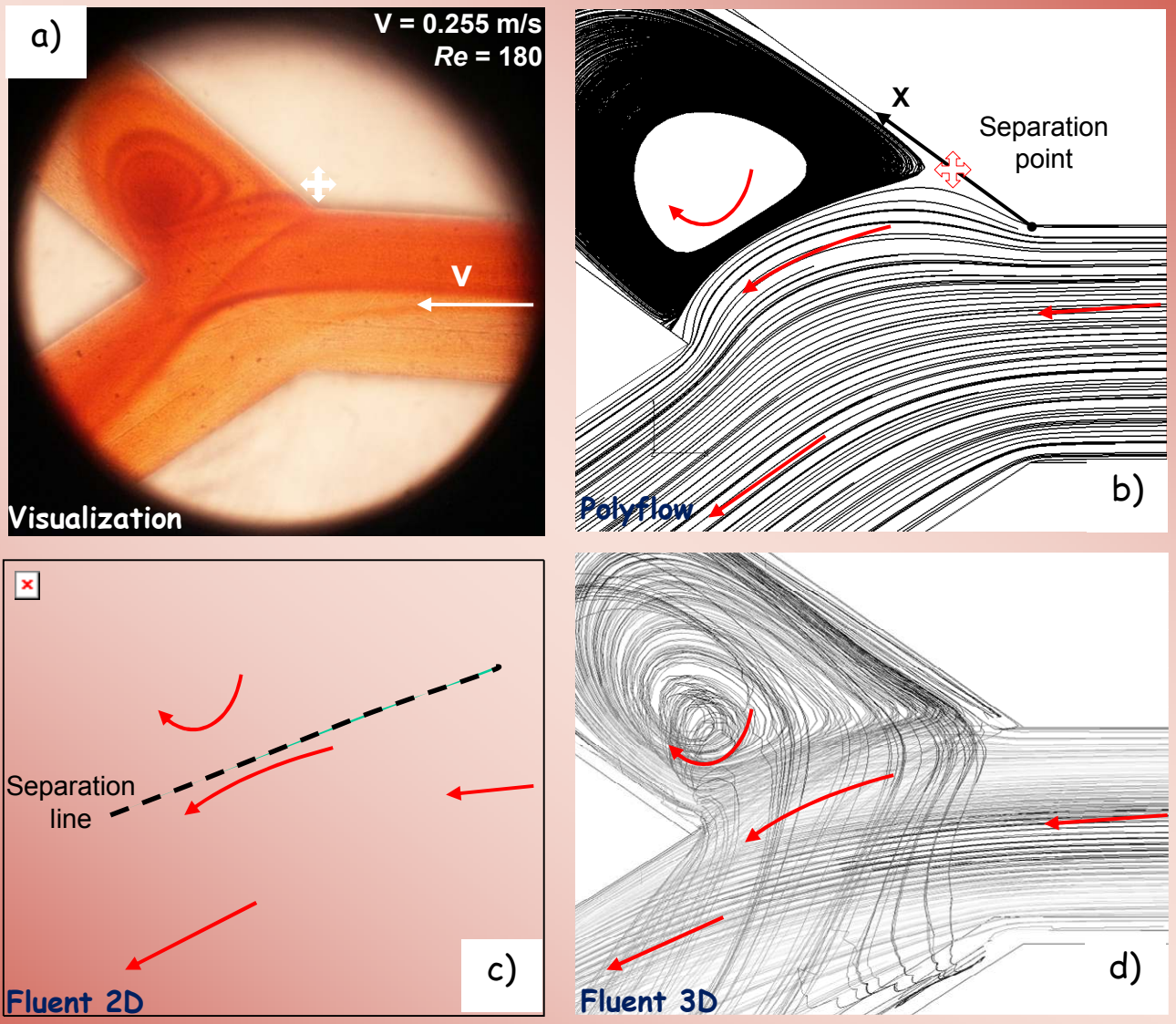




Experimental and Numerical Simulations for Newtonian fluid

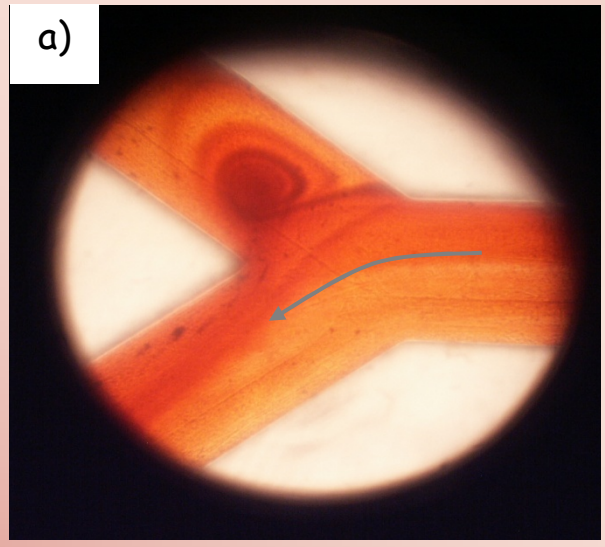


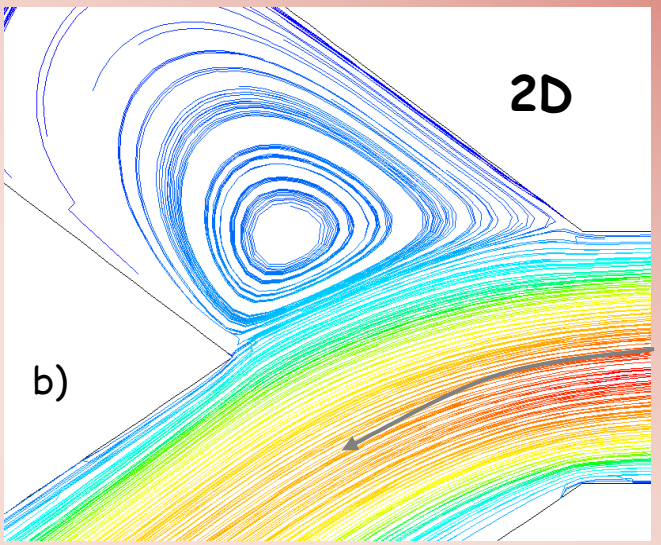
Visualizations (a) and numerical simulations of flow pattern in the junction for the Newtonian fluid at $Re = 95$ ($\eta_0 = 10^{-3}$). b) PolyFlow 2D; c) Fluent 2D; d) Fluent 3D.

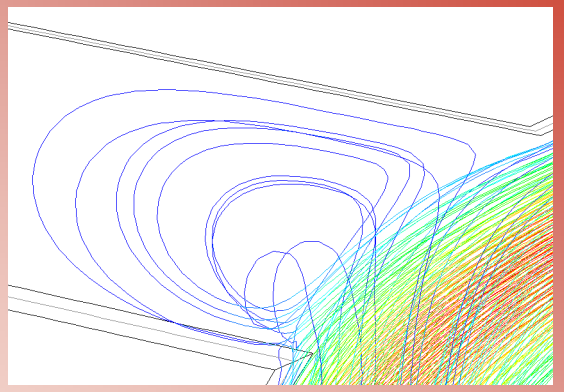


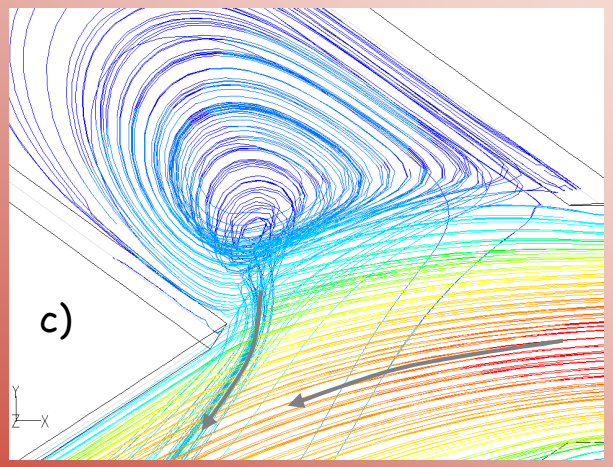
Visualizations (a) and numerical simulations of flow pattern in the junction for the Newtonian fluid at Re = 180 (η_0= 10^{-3} Pas). b) PolyFlow 2D; c) Fluent 2D; d) Fluent 3D.

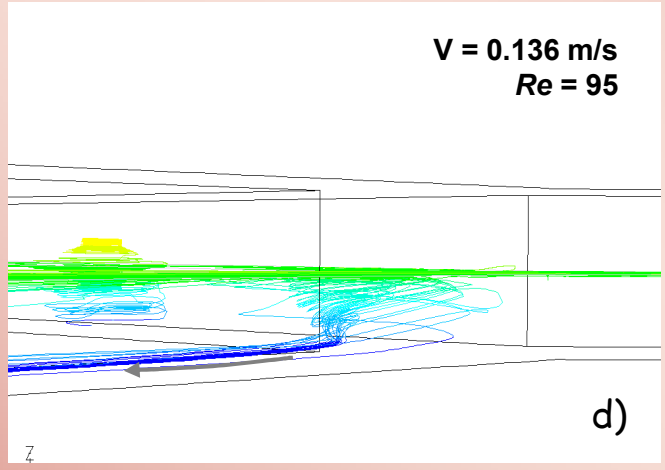
3D Flow Configuration

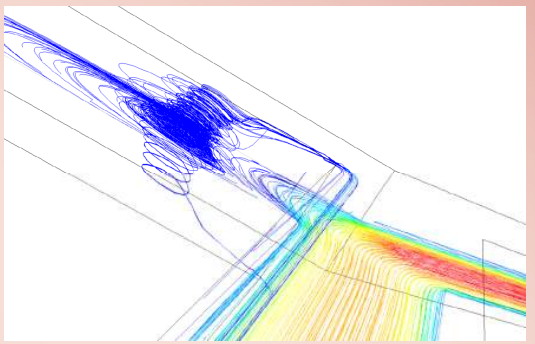








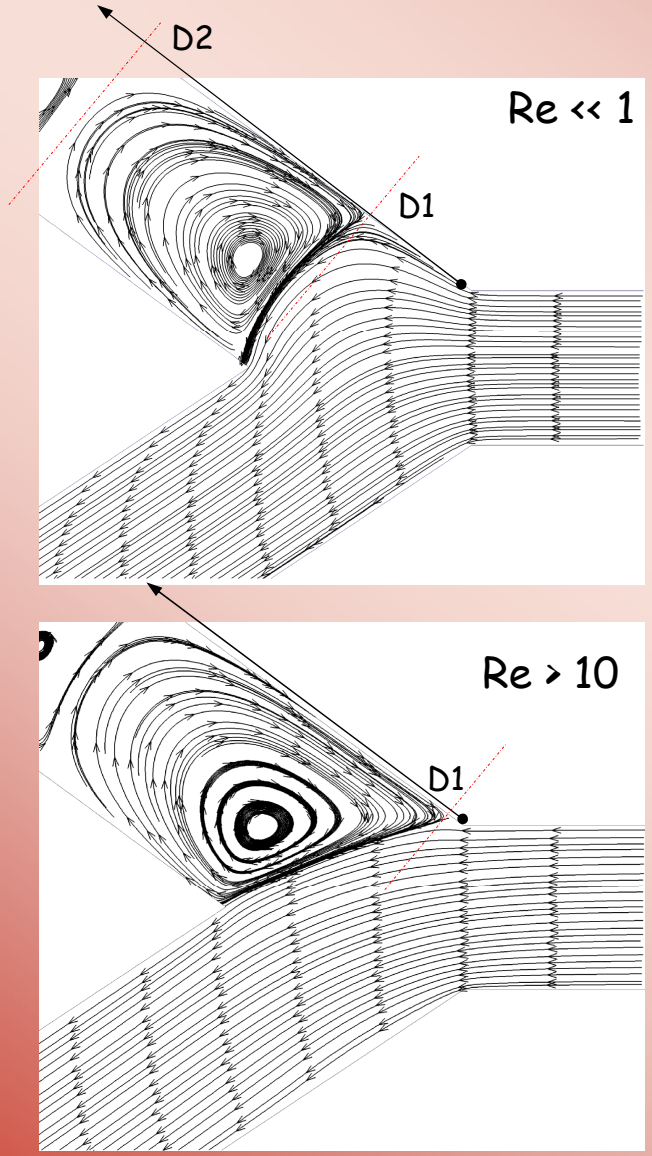


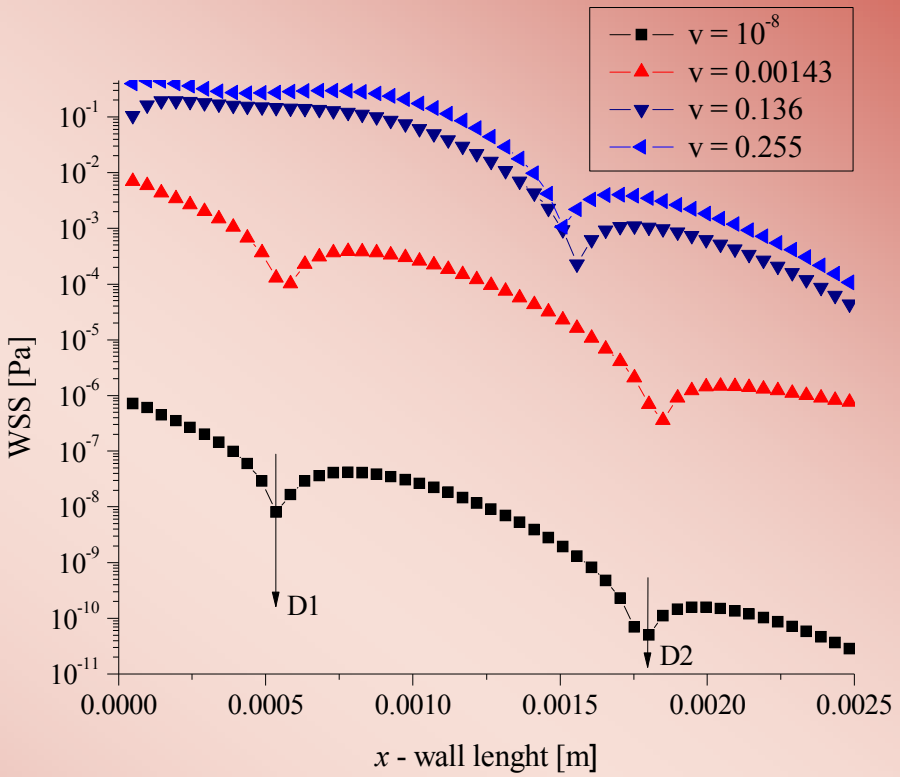


Comparison between experimental results, numerics Fluent 2D and Fluent 3D
a). Experimental b) Fluent 2D, patterns colored with velocity magnitude; c) Fluent 3D, patterns colored with velocity magnitude d) lateral view of 3D patterns, colored with normal position.

Application 1

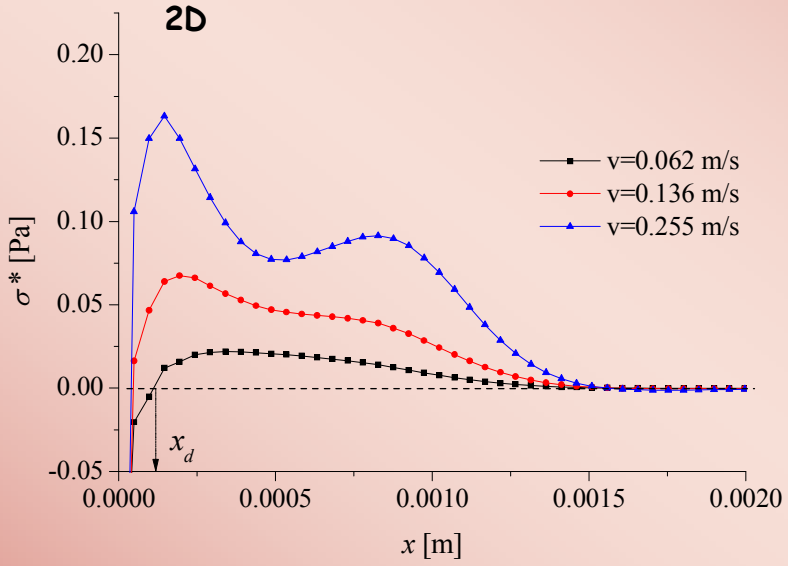
Wall shear stress (WSS) distribution

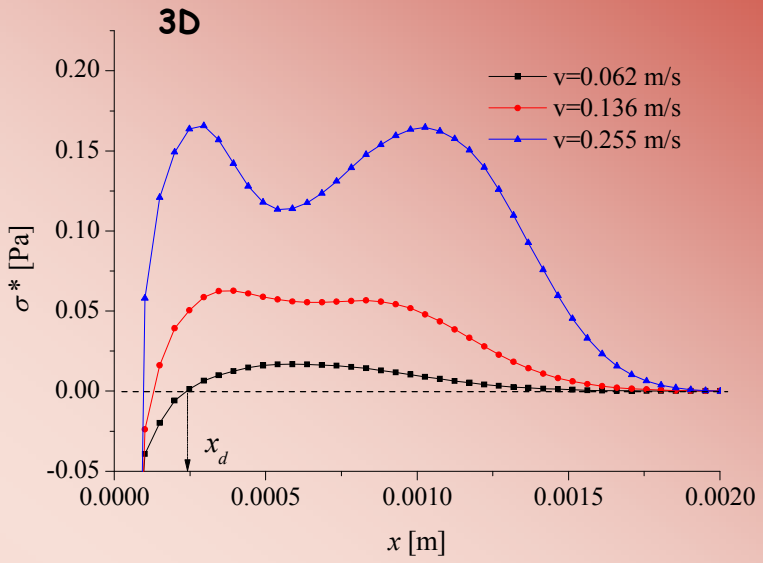


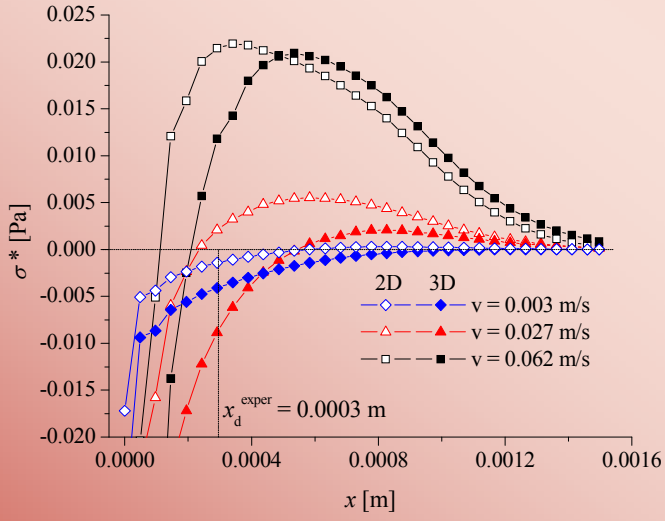


Wall shear stress distribution and the corresponding geometry of the vortical structure.

WSS distribution along the wall





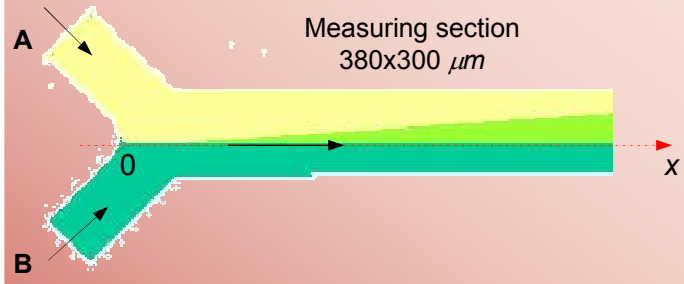


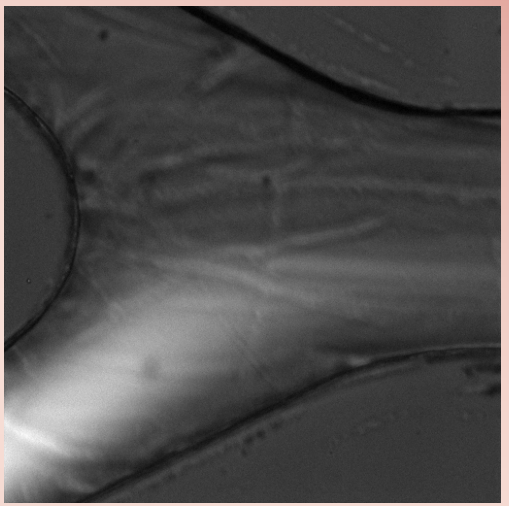
Comparison
at small *Re* - number

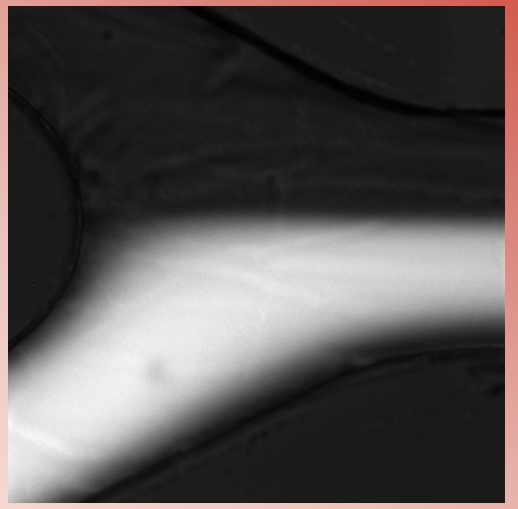
Application 2

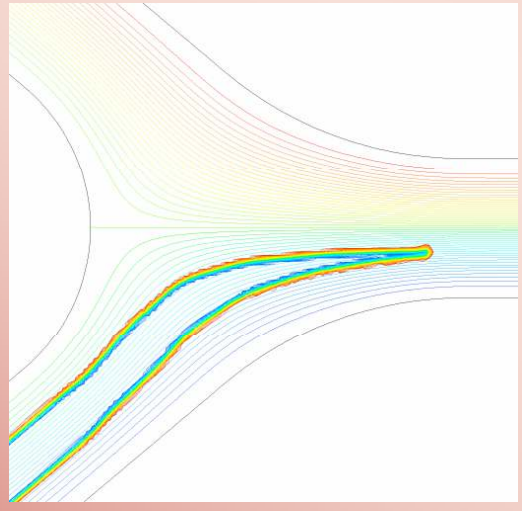
Mixing in a Y - profile

Confocal microscopy



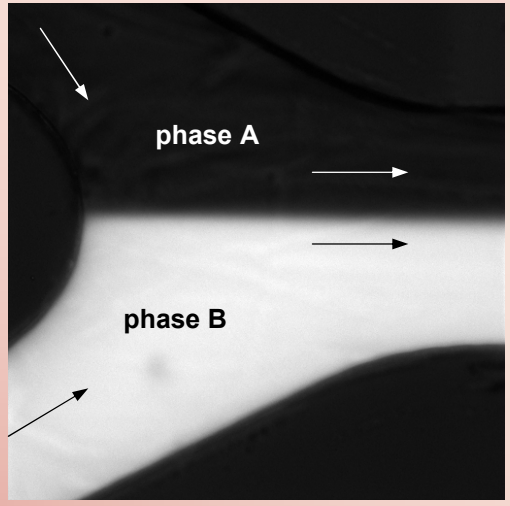


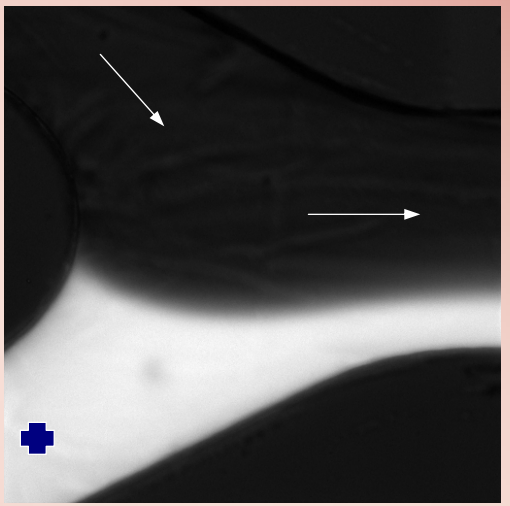


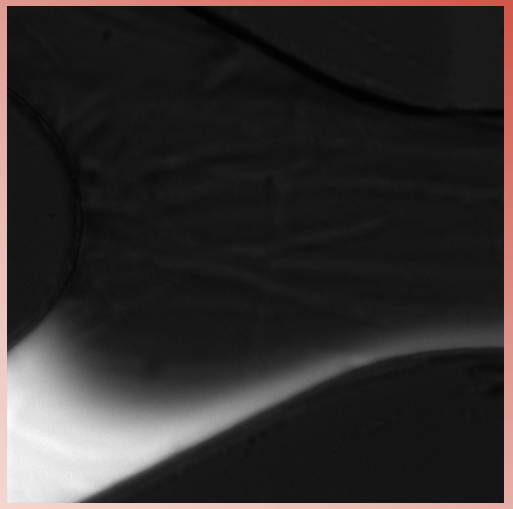


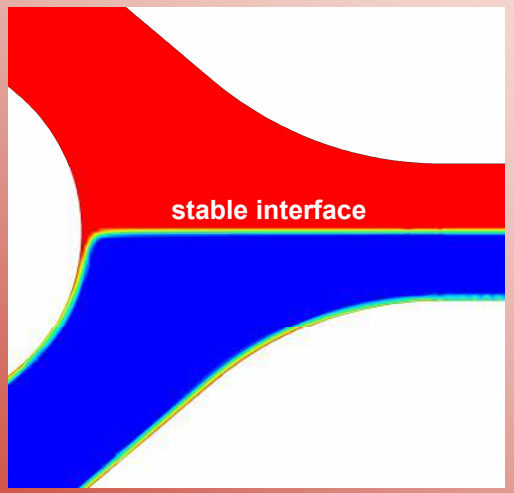
Time evolution of the interface

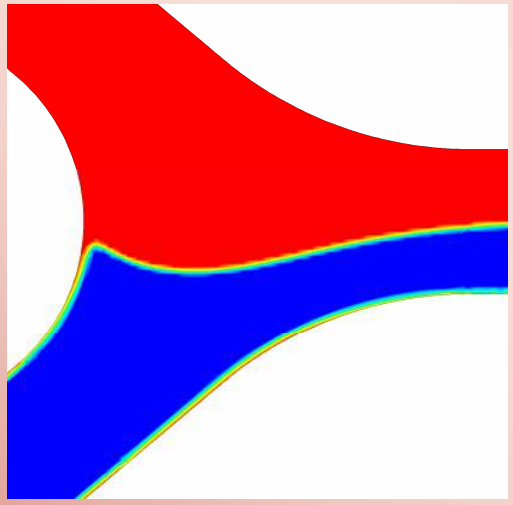
In cooperation with ICB and NUS

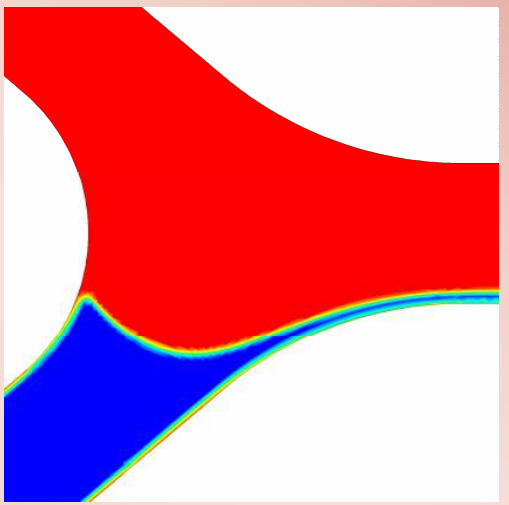












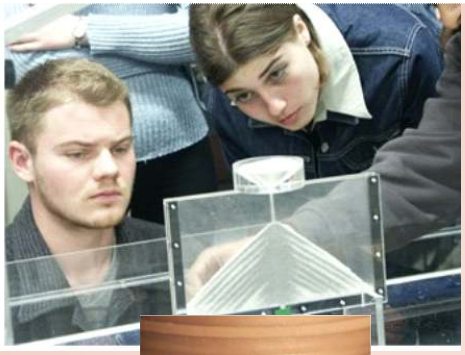
In cooperation with ICB and NUS

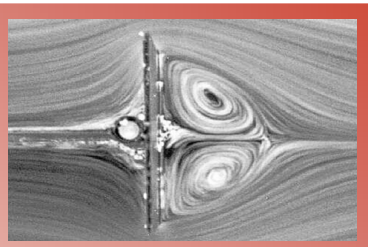
CONCLUSSIONS

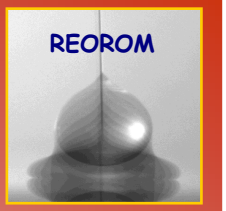
- CFD simulations, corroborated with experiments, is a value technique to extract the information about the flow structure and local dynamics in the vicinity of the micro-channels wall;
- Wall shear stress (WSS) distribution is fundamental for applications in the field of biofluid mechanics;
- **Cooperation and partners are fundamental !.**
  - **P.U.Timisoara;**
  - **International Center for Biodynamics, Bucharest;**
  - **Fundeni Clinical Hospital Bucharest;**
  - **"Petru Poni" Institute, Iasi.**

ACKNOWLEDGEMENTS

Romanian National Authority for Scientific Research (ANCS).
CNCSIS – Romanian National Council for Academic Scientific Research.







REOROM Group

Research unit under direction of
Professor Corneliu Balan
since 2000

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3 – 5 students in tests