Fibre suspension flow modelling

A key for innovation and competitiveness in the pulp & paper industry

FP1005

Start date: 11/05/2011

End date: 10/05/2015

Year: 3

Cristian Marchioli

Chair

CISM / Italy

COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

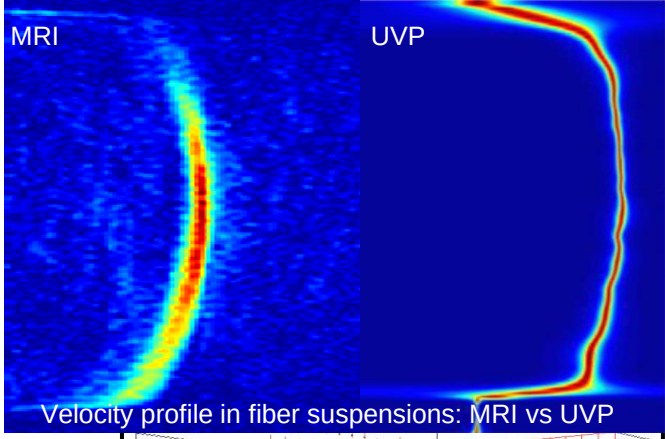
Scientific context and objectives (1/2)

- **Background/Problem statement:** CFD is far from being a mature research tool in the pulp and paper industry. The Action aims at showing how CFD can help to solve practical problems and decrease energy consumption of papermaking unit operations
- **Brief reminder of MoU objectives:**
  Main: to promote and disseminate validated experimental and numerical techniques in paper-making industry.
  Secondary: Knowledge Database for selected test problems, BPG for modeling fibre suspensions.

Scientific context and objectives (2/2)

- **Research directions:**
  - Promotion, dissemination and validation of CFD in paper industry is being achieved by joint meetings, written documents from meetings, public Knowledge Base repository.
  - The Action is enhancing transfer of innovative solutions to industry, but also the flow of information from practitioners to scientists through STSMs, training schools, workshops.
  - The Action is offering a forum to solve test cases relevant to industry and to compare simulated results to experiments.

Working groups



Velocity profile in fiber suspensions: MRI vs UVP

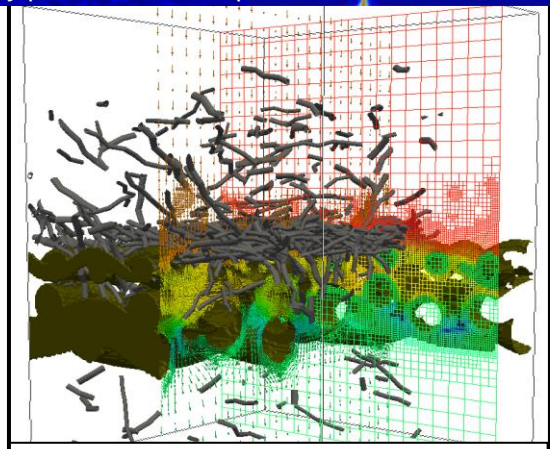
- **WG 1: Experimental Methods (~50)**

  Development of experimental techniques for measuring dilute/dense suspensions and non-Newtonian media
- **WG 2: Rheology Modelling (~30)**

  Predicting pulp behavior with single-phase continuum rheology (generalized-Newtonian viscosity models, fully non-Newtonian rheology models)
- **WG 3: Multi-Phase Flow Modelling (~50)**

  Modelling fibre suspension flows with multiphase Euler-Euler and Euler-Lagrange models (averaged phase eqns, trajectory tracking)
- **WG 4: Knowledge Transfer (~10)**

  Disseminate/transfer of know-why, know-what, know-how to industry



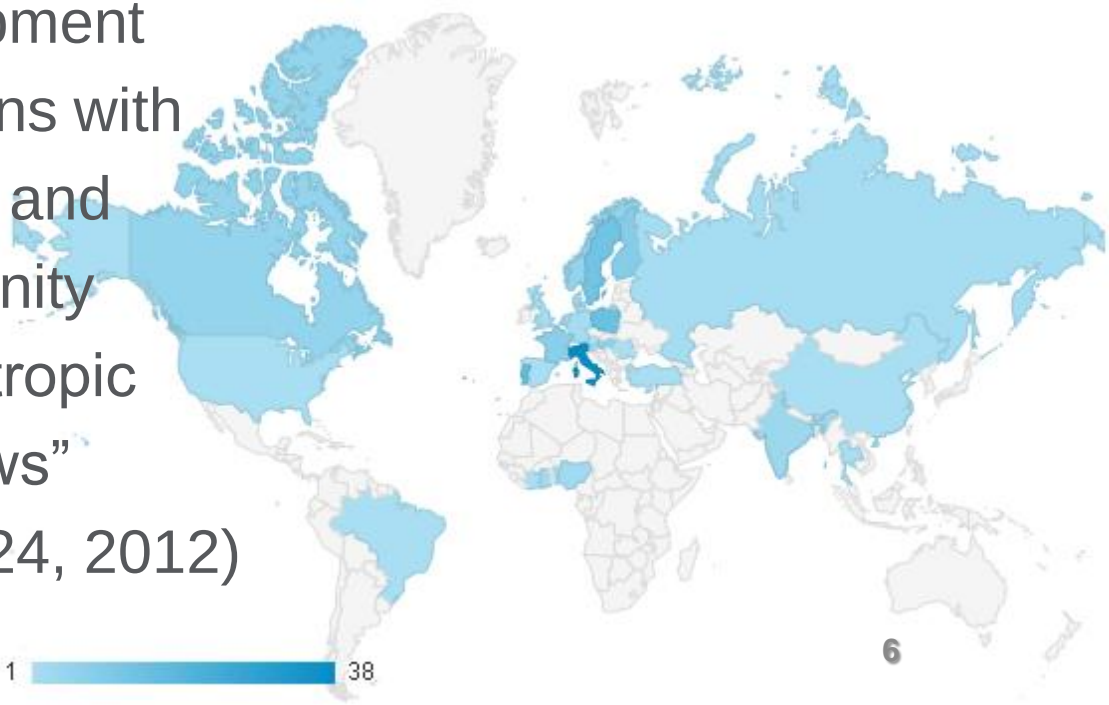
Multiphase simulation of fiber suspension flows using Immersed Boundary Methods (Svenning et al., Nordic Pulp & Paper Res. J., 27 (2012)

Results vs. Objectives

- R1: Successful *networking* via WG meetings (work getting focused), STSMs (work getting done) and TS (knowledge transfer to ESRs)
- R2: High level of *inter-disciplinarity*
- R3: Setup of *web infrastructure* for community building, document and data exchange
- R4: Submission of *joint proposals* to Horizon2020
- O1: Stimulate *scientific collaboration and scientific exchanges* among WGs
- O2: Allow *cross validation of tools* (access to at least one computer code and/or experimental equipment)
- O3: Increase *industrial participation*

Significant Highlights in Science or Networking

- The Action website is the reference scientific resource of data, documents and updates on “Fiber suspension flows” on the web (PageRank: 6/10)
- Knowledge Base: database of raw scientific data from simulations and experiments. Action FP1005 is putting a lot of effort in its development
- Established collaborations with Action MP0806, Nordita and the ERCOFTAC community
- Special Issue on “Anisotropic particles in turbulent flows” (Acta Mechanica, vol. 224, 2012)



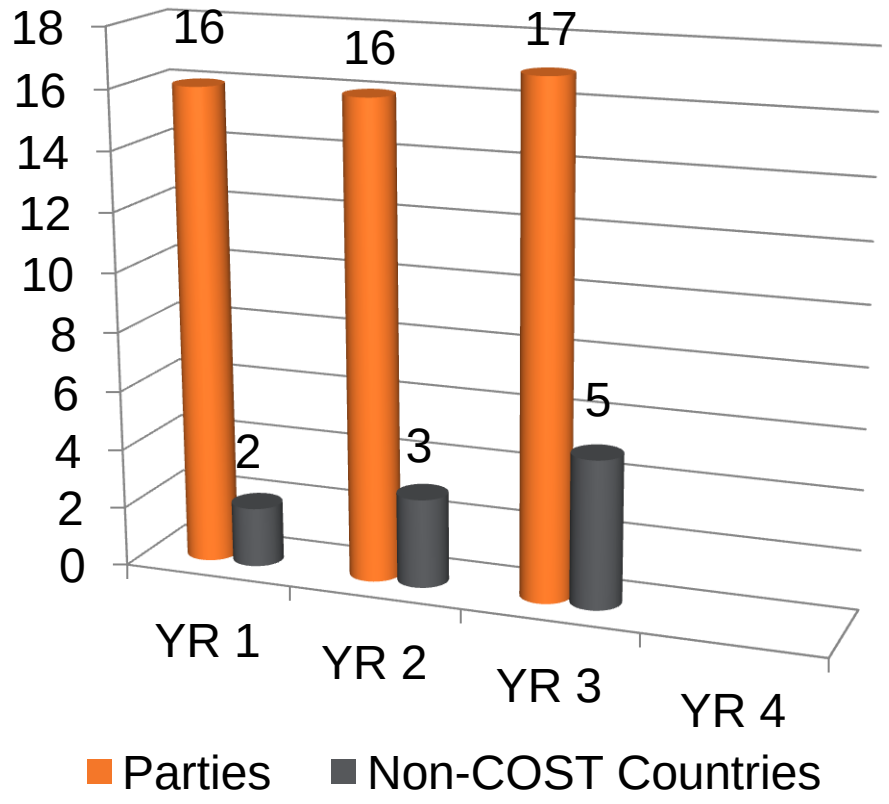
Significant Highlights in Science or Networking

- STSM #11624, Applicant: Sanna Haavisto (ESR)
- Title: Fiber suspensions in turbulent channel flow
- *Scientific advancement*: combination of experimental techniques (MRI, OCT, LDA, UDV) to measure the wall-layer dynamics for fibre suspension flows
- *Networking*: collaborative study among WG1, WG2 and WG3 participants (from UCDavis, UBC, VTT)
- *Dissemination* of results at the 15th Fundamental Research Symposium on *Advances in pulp and paper research* of the Pulp & Paper Fundamental Research Society (Cambridge, Sept. 2013)

Challenges

- No significant deviations from work plan expected
- Critical phases to be implemented or topics to be addressed during the 3rd/4th year:
  - Disseminate the Knowledge Base among potential users (industry)
  - Increase participation of industrial practitioners
  - Keep the level of scientific collaboration and paper production through WG meetings
  - Stimulate further STSMs
  - Submit new project proposals (Horizon2020, MC)

Action Parties



Grant Holder:

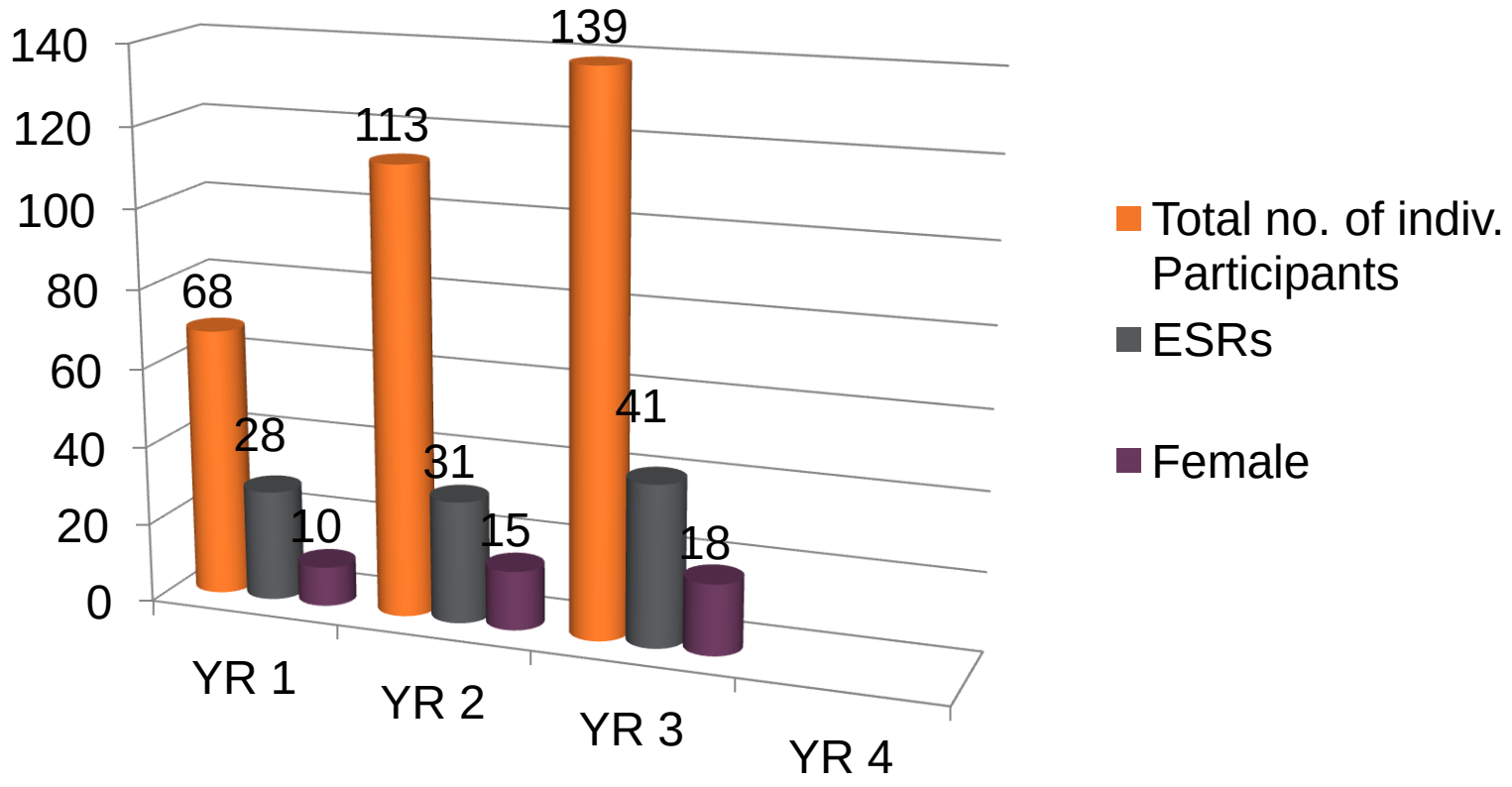
CISM

Scientific Representative:

Cristian Marchioli

GH Country: Italy

Action participants



Use of COST Instruments

Activity (No.)	Year 1	Year 2	Year 3	Year 4
MC/WG Meetings	2	2	2(1)	-
STSMs	5	11	7(5)	-
Training Schools	1	1	2(2)	-
Workshops or Conferences	1	2	4(3)	-
Joint Publications	2	8	14(7)	-