fluidyn

**FLUIDYN,** a group founded in 1987, has been offering coupled multiphysics modeling software for process optimization, environmental impact, and industrial hazards assessment.

**FLUIDYN** offers 3D CFD modelling tools covering all design and optimization issues for industrial processes by coupling the behavior of fluids and structures undergoing thermal or mechanical deformation. **FLUIDYN -MP** is extensively used in industry, especially for transient problems requiring coupled simulation of fluids & structures. For environmental and risk analysis, **FLUIDYN -PANACHE**, **FLUIDYN -FLOWSOL & FLUIDYN -VENTIL** cover the topics of pollutants dispersion indoors and outdoors, water dispersion as well as fires & explosion with effect on structures. **FLUIDYN -REALTI**, is a 3D platform to model leak and odour dispersion in real time. Two most recent innovations are **FLUIDYN -SENSORMAP** dedicated to atmospheric emissions monitoring by inverse modelling of sensor data and **FLUIDYN -BFC**, numerical platform dedicated to battery and fuel cell modelling.

**FLUIDYN** also offers **consultancy and R&D expertise** to support design and maintenance services for different industrial and research sectors: nuclear, petrochemical, defense, aeronautics, automobile, agrifood, industrial process optimization, bioengineering, ventilation, environment, industrial risks, waste treatment, military / harbor / chemical.

#### **APPLICATIONS**

- Multiphase flows dispersed and free surfaces
- **f** Fluid-structure interaction
- **f** Conjugated heat transfers
- **f** Combustion and reactive flows
- fluid and electromagnetic coupling
- Acoustic-fluid-structure coupling
- 🛃 Ventilation and atmospheric dispersion
- 🛃 Process optimization, defense and nuclear
- **f** Environment and risks explosions, fire
- 🛃 Bio-medical
- **f** Electro-, chemo-, magnetohydrodynamics

#### REFERENCES

**Petrochemicals**: ALKION, BP, BV, ENGIE, HPCL, JACOBS, L&T, ONGC, RELIANCE, SINOPEC, TECHNIPFMC, TOTAL, TRAPIL **Chimie et agroindustry**: AJINOMOTO, AIR LIQUIDE, AIR PRODUCTS, BASF, BAYER, CRISTAL UNION, INEOS, KPCL, McCAIN, MITSUBISHI, SANOFI, SOLVAY, SUMITOMO, SYCTOM

**Process**: ARCELOR-MITTAL, JINDAL, LAFARGEHOLCIM, MICHELIN, NIPPON STEEL, RIO TINTO, SITA, THYSSENKRUPP, VEOLIA, VINCI

**Nuclear**: ANDRA, BARC, British Nuclear, CEA, China NSC, CIRP, CNNC, EDF, FRAMATOME, IGCAR, ILL, L&T, ITER Organisation, ITER India, JAEA, NPCIL, ORANO, ROLLS-ROYCE, SNERDI, TRACTEBEL

Automobile-Defense-Aerospace: AIRCELLE, BOSCH, CRYOSTAR, DGA, DRDO, DRDL, EADS, GABRIEL, HAL, INDIAN RAILWAYS, NAVAL GROUP, RDSO, ISRO, RATP, RENAULT, SHAR, SNCF, STBFT, TVS Motors, VSSC, ZODIAC

Academic, R&D and Govt. agencies: Universities-Berkeley, Beijing Institute of Technology, Saclay, Centrale Supelec, Centrale Nantes, CVUT, ENSMA, ESAIP, Evry, IIT, NIT, INSA, Nottingham, Saint Quentin, Marne la Vallée, Versailles, City Councils-Paris, renoble, Saint Denis, Govt. agencies-SIAAP, Departmental Councils, KPCB... amongst others.

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# MULTIPHYSICS FLUID -STRUCTURE-HEAT TRANSFER





CONSULTANCY SERVICES DESIGN EXPERTISE MODELLING TOOLS 3D SIMULATIONS













# fluidyn-MP

# **MULTIPHYSICS PLATFORM**

#### General numerical platform for modelling coupled multiphysics phenomena

- Multiphase, compressible, and reactive flows
- **f** Fluid-structure interactions
- 🛃 Fluid structure heat transfer and stress
- **f** Coupled electro-chemo-magneto-hydrodynamics.
- **f** Porous media with heat transfers
- **f** Explosions and structural deformation

#### Multiple solver and solution schemes

- 🛃 Simultaneous calculation of heat conduction, deformation, and fluid structure movements
- 🛃 Coupled thermo-mechanical interaction.
- **f** Finite volume solver for fluid flow
- Finite elements solver for structures, heat conduction and acoustics

fluidyn-NS

fluidyn-FSI

fluidyn-CHT

fluidyn-ESR

fluidyn-HSR

*fluidyn-*dB

fluidyn-PANACHE

fluidyn-FLOWSOL

fluidyn-VENTIL

#### **MODULAR SOFTWARE**

#### Specific domains:

- **f** Computational fluid mechanics:
- **f** Fluid-structure-acoustic interactions:
- **f** Heat transfer and thermal stress:
- **f** Explosions and structural deformations:
- Magnetohydrodynamic and electrochemical coupling: *fluidyn*-MEHD
- **f** High strain rate structural deformations
- **Application areas:**
- Air quality and atmospheric pollutant dispersion:
- **f** Surface and ground water dispersion:
- **S** Noise propagation in atmosphere and volumes:
- HVAC, explosion, and dispersion in closed spaces: **Customized software development:**
- J User customized CAD interface for data input
- 🛃 Integrated features for parametric and optimization studies
- **f** Physical models and parametric equations
- **f** State of the art numerical solvers

#### **COMPLETE SOFTWARE SOLUTION**

- f Multiprocessor solver available on Windows / Linux
- 🛃 All tools in a single interface: CAD, mesh generator, pre-post-processor, solver
- **f** User-defined routines
- **f** 3D complex mesh generator: Fluid-Structure
- 🛃 Import formats: IGES, STEP, SolidWorks, Parasolid, AutoCAD, IDEAS
- **f** Efficient repair tools
- f Preprocessing and case setup  $\rightarrow$  groups, boundary conditions, material database



# *fluidyn-*MP-NS

- **3** 3D Navier-Stokes with high order precision finite volume implicit / explicit solver
- 🛃 3D structured / unstructured, embedded, adaptive, fixed or moving mesh
- 🛃 Reactive, multispecies flows: convection-diffusion equations, Arrhenius, EBU EDC, BML, etc..
- 🛃 Two-phase flows: Euler-Lagrange, droplets, particles, bubbles, phase change
- 🛃 Highly compressible/incompressible, laminar/turbulent, steady / transient
- f Turbulence: : k- $\varepsilon$ , k- $\omega$ , Lam-Bremhost, SGS, Magnusson, Eddy dissipation, LES
- Multiphase flows: free surface, dispersed, DEM, super critical
- 🛃 Perfect / real gas, Newtonian, or non-Newtonian flows
- Surface or volume porosities with heat exchange

## **FLUID-STRUCTURE INTERACTIONS**



# fluidyn-MP-CHT

- 🛃 Coupled thermo-hydro-mechanical modelling for flows and structures conduction and thermal stress / strain in finite volumes
- 🗲 Fluid flow and heat convection in 3D finite volumes coupled with 🛃 Radiation models with semi-opacity, shadow effect 🛃 Transient (implicit or explicit scheme) or steady state analysis **f** Turbulence, reactive, condensation and evaporation models 🛃 Permeability laws, LTNE models for porous media Multi block structured, unstructured, moving, hybrid mesh 🛃 Material models with thermal effect **f** Thermal creep in structures



### **INTERNAL AND EXTERNAL FLUID FLOWS**



# fluidyn-MP-FSI – MP-ESR

- **f** 3D finite volumes and finite elements solutions
- 🛃 FSI coupling by ALE or IBM, auto-adaptive mesh for structural deformation
- Fast transient, compressible flows (detonation, deflagrations) Multi-species, multiphase flows (dispersion or free surface) 3D hexa or tetrahedra's, thin plates, beams, and spring elements
- Transient (implicit or explicit scheme) or static analysis
- Elastoplastic / piece wise linear materials
- Orthotropic, sandwich, anisotropic materials
- Large transient displacements of structures: valves, pistons...
- Vortex induced vibration with acoustic interaction
- Explosion modelling with BML or JWL models
- 🛃 Elastic, elasto-plastic, hyper-elastic linear deformations

### **CONJUGATE HEAT TRANSFER**