Oofelie::MEMS

Oofelie Multiphysics 2010

Oofelie::MEMS, driven by SAMCEF Field, provides engineers and analysts with unique capabilities to analyze MEMS behavior. With Oofelie::MEMS you are getting the core of the physics in one conveniently integrated simulation package.

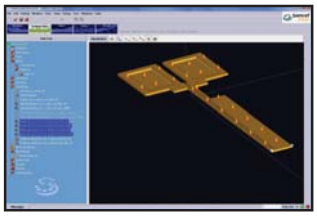
Oofelie::MEMS provides a solution for full coupled analysis. Any MEMS problems exhibit a more or less pronounced coupling behavior, resulting in the mutual influence of the structural - thermal - fluidic - electric fields. To obtain an accurate prediction of the response, a coupled approach is mandatory. Oofelie::MEMS offers a built-in, simultaneous solver for the whole system, thus providing a better solution accuracy for strongly coupled cases.
Reduced design time, improved quality and reduced costs are some of the benefits one can now obtain using Oofelie::MEMS.

MODELING ENVIRONMENT

Oofelie::MEMS is driven by a user-friendly integrated graphical user interface, SAMCEF Field, for the modeling, the analysis and the post-processing of MEMS systems.

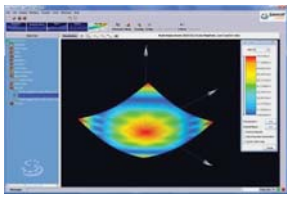
SAMCEF Field, a complete and interactive user environment providing all the tools necessary to design, simulate and analyze a range of configurations, has been tailored to approach efficiently the field of MEMS design. Its visual and hierarchically arranged layout will guide you through all the steps of model preparation, resolution procedure and analysis.

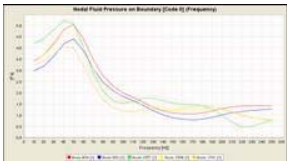
A CAD **modeler**, that provides geometry importation **and cleaning capabilities** from other leading CAD providers, is integrated for modeling and **data preparation**. As data are directly defined on the geometry, users can easily switch system components modeling level from one behavior to another.



Parameterized data entry is easily done through contextual pull-down menus and pop up boxes using a wide selection of preprogrammed functions for the definition of time and frequency varying properties and boundary conditions. Finally, notice that SAMCEF Field is MEMS Pro (SoftMEMS) compliant.

As soon as the analysis is completed, the results are easily accessible from a simple click in the navigator. Results may be displayed in different forms over the whole model or through user's defined cross-sections to study detailed behavior. In addition to all the state-of-the-art **standard graphic outputs (i.e. X-Y plots, isovalues, animations, etc.),** results may also be inserted in tabular forms in the analysis report. SAMCEF Field is common to all the solutions provided by Open Engineering, allowing other analyses to be performed on the same model as for piezoelectric simulations.





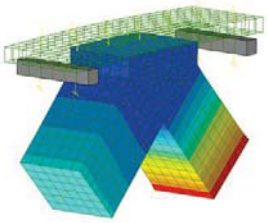
PLATFORMS

Oofelie::MEMS, driven by SAMCEF Field, is available on Windows and Linux platforms.

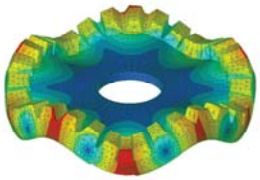
PIEZOELECTRIC ANALYSIS

The general three-dimensional models offer generalized methods that can be adapted and used for many different applications in the transportation (aircraft, automotive), equipment (machinery, motors, sound systems), electronic appliances, biomedical and building industries for instance.

To accurately model the behavior of piezoelectric systems, the strong coupling between the mechanical and electrical fields is considered in the solution approach.

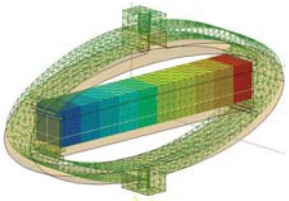


PIEZO LINEAR ENGINE



ULTRASONIC ENGINE

The strongly coupled static, modal, harmonic and transient behaviors can be easily simulated with Oofelie::PiezoElectric to optimize the input and output parameters. In the case of actuators, the analysis focuses mainly on the mechanical response due to an electrical loading and in the case of sensors, on the inverse phenomenon.

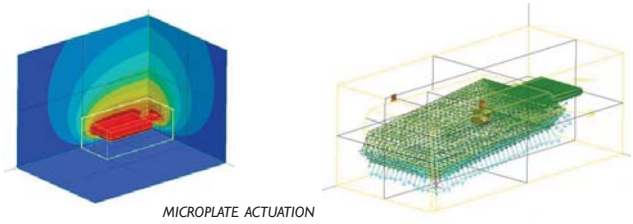


APA ACTUATOR

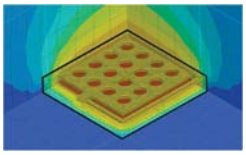
DIVA, COURTESY OF ONERA

ELECTROSTATIC ACTUATION

The electrostatic capabilities are dedicated to the modeling of the behavior of electrostatically actuated systems.



MICROPLATE ACTUATION



ELECTROSTATIC ANALYSIS OF A MEMS

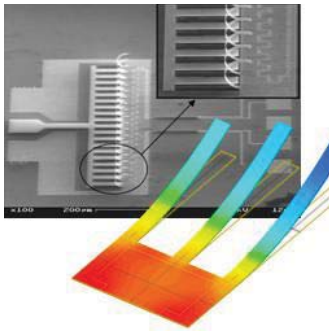
MICROLENS ACTUATION

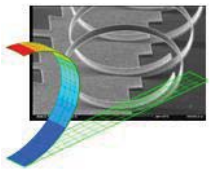
WITH COURTESY OF UBC & BCCRC, CANADA

This feature is very flexible thanks to the use of the conventional finite element method (FEM), together with the boundary element method (BEM). This last method is efficient for taking into account the contribution of infinite medium. Also, a Fast Multipole Method (**FMM**) algorithm can be used, in some specific cases, to solve very large electrostatic problems with BEM techniques.

THERMO-MECHANICAL AND PYRO COUPLINGS

The **Oofelie::MEMS** product contains all the capabilities of the Oofelie::PyroPiezoElectric product, where the thermal field and its couplings with mechanical and electrical fields are taken into account in the strongly coupled analysis procedures.





FLOW SENSOR

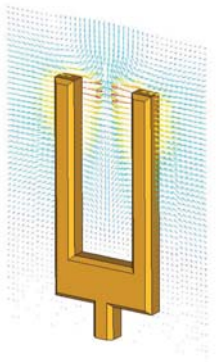
A relevant feature is the prediction of the **thermoelastic damping** which is generally the main source of damping in small vibrating structure.

For a complete description of all available thermo-mechanical and pyro couplings features in Oofelie::MEMS, please refer to the Oofelie::PiezoElectric brochure.

FLUID DAMPING

For MEMS devices that are not packaged in a vacuum environment, the management of the surrounding fluid medium is mandatory. Indeed, it induces an additional damping effect that modifies the dynamic behaviour of the system.

A BEM Stokes fluid incompressible formulation is implemented in Oofelie::MEMS to model this damping effect.



DIAPASON

SUPER ELEMENT MODELS (SEM) GENERATION

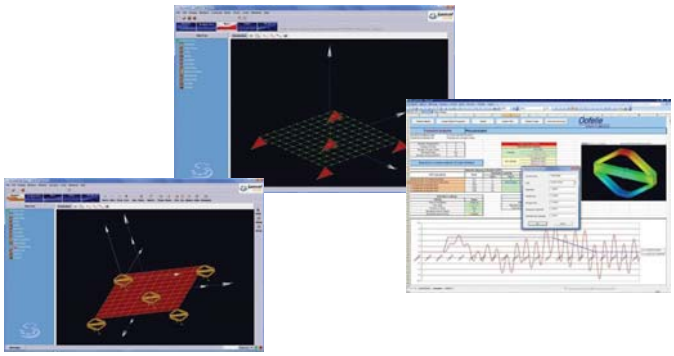
Thanks to the strong coupling approach, model reduction techniques are available to generate accurate but fast models of components that can be introduced in other electronics.

Efficient and innovative reduction methods have been developed in Oofelie, which allow the generation of parameterised multiphysics reduced models that are fully compatible with static, modal, dynamic and harmonic simulations. The use of reduced models can lead to significant improvements in terms of simulation time and memory requirements. Furthermore, the ability to re-use components and to generate models that represent families of components, thanks to the parameterisation features, can speed-up the time-to-market.

The reduction methods available in Oofelie can be applied to structural, thermo-mechanical, piezoelectric and thermo-piezoelectric models.

Due to the dynamic reduction approach, reduced models take into account the complete behavior of the models, including stiffness, inertial and damping effects. In addition, all the reduced model variables correspond to input-output quantities and therefore the excitation scheme must not be defined a priori when generating the reduced model.

Reduced models can also be exported to systems simulators using **VHDL-AMS or Verilog-A** exchange formats. It is also possible to add and connect multiple RLC circuit elements to model the connected circuitry directly inside Oofelie::Mems..



SoftMEMS
Bringing MEMS to the Mainstream

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