Cemracs'11 : HPCVES Project
High Performance Computing and Numerical simulation of vesicles

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Complex fluids are the rule rather than the exception in the industrial and biological worlds, conferring thus to this topic a considerable interest in various domains ranging from fundamental research to advanced technological development. Typical examples of complex fluids are suspensions (rigid or elastic particles suspended in a Newtonian fluid) or emulsions (droplets suspended in a Newtonian fluid). For example, blood, the simulation of which is of paramount importance in medicine and biology, is a suspension of red blood cells in plasma.

Complex fluids exhibit several puzzling behaviors that critically depend on the underlying structures that compose the fluids. Indeed, the overall rheological properties of complex fluids composed of microscopic entities (such as rigid or soft particles, biological cells, macromolecules, etc...) suspended in a liquid, are strongly influenced by the individual and collective behavior of such entities.

In order to correctly simulate the behaviour of such fluids, a significant challenge to be faced lies then in the understanding

- of the interaction between the fluid and the suspended entities at the individual level (fluid/structure interaction);
- of the space-time organization of the entities (i.e. their collective behaviors, like jamming, formation of bands...) composing the complex fluid.

In this work, we plan in particular to simulate the suspension of *vesicles* (which represent a good model of red blood cells) in confined and extended flows using the `Feel++`[1] Library. When dealing with concentrated suspensions, the computational costs increase significantly. To reduce these costs we will then need to resort to different numerical tools (e.g. level set methods, fictitious domain techniques, domain decomposition) combined with HPC techniques and parallelization.

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