

ELEM Biotech

The Virtual Humans Factory

Vázquez, M.^{1,2}, Morton, C.¹, Houzeaux, G.^{1,2}, Cela, J.M.^{1,2}

¹ELEM Biotech SL, Spain

²Barcelona Supercomputing Center, BSC, Spain

"Imagine a Virtual Human, not made of flesh and bone, but made of bits and bytes..."

1. Introduction

In Barcelona, July 2018, the Barcelona Supercomputing Center (BSC), the Technical University of Catalonia (UPC), the Spanish Superior Council of Scientific Research (CSIC), three researchers and a business-background entrepreneur, founded the start-up company ELEM Biotech (<http://www.elem.bio>). The company is in charge of developing and commercialize a set of high-tech simulation technology targeting the biomedical sector. The core technology is Alya, the parallel multi-scale / multi-physics simulation software developed at the Barcelona Supercomputing Center, by a team led by Mariano Vázquez and Guillaume Houzeaux. The company is based in Barcelona, with an office in Bristol (UK).

2. Technology

The goal of the company is to develop a set of tools and services, which the customers can use to test their products. The customers are medical devices manufacturers and pharmaceutical companies. Using different data analysis techniques, ELEM creates a Virtual Patient on which medical devices or drugs can be safely and rapidly tested.

The core technology is Alya, the parallel multi-scale / multi-physics simulation software developed at the BSC. Since its conception in 2004, Alya is designed to work efficiently in large-scale supercomputing facilities. M. Vázquez and G. Houzeaux are the main architects, gathering a group of programmers/researchers/developers of around 40 in BSC and another 20-30 outside BSC. Alya allows to simulate physical problems such as fluid mechanics, solid mechanics, electrophysiology, particles or heat transport and coupling them through fluid-structure interaction, contact, heat exchange, particles transport, etc. The key point is that coupling must remain as efficient as the individual problem solutions thanks to specially designed algorithms and programming strategies. We refer the reader to [1] where the largest coupled electromechanical simulation of a heart is reported, using NCSA Blue Waters supercomputer in runs up to 100.000 cores on meshes with more than 3 billion elements.

The technology which makes ELEM Biotech unique includes also a cloud-deployment software infrastructure (currently in Oracle Cloud Infrastructure, but cloud-provider agnosticism allows us to rapidly and flexibly deploy the infrastructure somewhere else) and a so-called Biomedical Interface to allow the users to setup and analyse their problems.

3. Application

Currently, ELEM's main application domains are cardiovascular and respiratory systems. We can simulate three-physics cardiac problems (fluid mechanics, solid mechanics and electrophysiology) to study medical devices deployment and operation, such as pacemakers, stents, valves, etc. On the other hand, we can simulate full geometries of the respiratory system, from face down to several bronchi bifurcation levels.

4. References

[1] Vázquez, M., Houzeaux, G., Koric, S., Artigues, A., Aguado-Sierra, J., Arís, R., Mira, D., Calmet, H., Cucchietti, F., Owen, H. and Taha, A., 2016. Alya: Multiphysics engineering simulation toward exascale. *Journal of computational science*, 14, pp.15-27.