Journal of Biosensors & Bioelectronics

Kafashan, J Biosens Bioelectron 2013, 4:1
DOI: 10.4172/2155-6210.1000e118

Editorial Open Access

Computational Simulations: Alternative Solution in Sensing and Monitoring of Biomaterials

Jalal Kafashan

DEM Research Group, Division of Mechatronics, Biostatistics and Sensors, KULeuven, Belgium

Editorial

In the latest years, computer-aided engineering (CAE) has evolved with the development of computer technology. Nowadays, many engineers and scientists switch on computer simulation to take advantage of this trend in their domains. In engineering, this is to supply a considerable clue of unknown, difficult-to-estimate mechanical behaviour of materials over the time. Therefore the number of implemented simulations increases day by day and the applications as well. The main reason is that simulating is low cost and the technical results can be provided in much detail. In addition, the advantage of computational simulation consists of being easily implementable, mostly extendable, and quickly repeatable. These days, computational biology is playing an increasingly significant role in the biological-related issues [1]. Various single-cell-based models have been developed and implemented to biological and medical problems [2], while the simulation of the huge number of particles are still in an infancy step in many cases.

This editorial article intends to familiarize the readers with the alternative solution instead of sensing and monitoring of biomaterials that is being developed for attaining quality and quantity of biomaterials recently, although it is not only focused to offer a comprehensive review on simulation systems.

Sometimes simulation is the only way to validate or verify a process. Two big advantages can be mentioned to perform a simulation rather than a real measurement, biosensing, a real monitoring and test. The first and the majority of these advantages are not only funds but also hazardous issues. Experiment, devices, testing, retesting, sensing, monitoring in biomaterials and other steps of a bioprocess for no matter which, can be a great deal with staff, time limitations, facilities, specific conditions and budget. Furthermore, simulation avoids destructive test in any bioprocess and biomaterials, which is a big advantage in an unrepeatable biomater.

Simulation testing is normally faster, cheaper and more flexible than executing several measurements or tests every time. The next key advantage of a simulation-based approach is the level of detail that can be obtained from a simulation. A simulation can provide some results when no way is practically accessible or any limitation exists in sensing and measuring some parameters with the current level of technology even high-tech. There are various sufficient reasons to use it, since, in every phase of any bioprocess (such as design, production, and operation), there are many chances for errors that can result in damage, failure and any unwanted outcome.

The ability of simulation is to supply a considerable indication of unidentified, difficult-to-estimate biomaterials behaviour especially in a dynamical process. For instance, owing to handling and transportation, the dynamical behaviour of biomaterials causes mechanical damages that can be predicted and facilitated when a simulation is very well-structured in an appropriate programming. Simulations can be set in any arbitrary very small time and space scale with no interruption or disturbance during the performance of a system. There is an incomplete list of the main advantages of computational simulations [3,4]. In general, the finite element method (FEM), computational fluid dynamics (CFD) and smoothed particle hydrodynamics (SPH) are well-known mathematical tools for engineering simulation in solid and fluid mechanics, which should be mentioned here.

In the investigation of dynamical phenomena, some unformulated behaviours are neither solid-like nor fluid-like. The dynamics of particulate biomedia's behaviour is complicated as a result of the complexity of interactions between particulate matters and other surrounding boundaries such as container, pipe and conveyor. Hence, the above-mentioned methods have no ability to simulate such phenomena occurring in most of granular media. Whilst fluid dynamics is usually known to follow Navier–Stokes equations, the motion of granular media presents dissimilar features depending on the system, media concentration and relations, performance solid-like or liquid-like behaviour, and a mixture of different behaviours with more complex rheological reaction. Even though a large set of information about experiments on different granular media is accessible nowadays, an appropriate argument and perceptive of the involved phenomena can't be achieved without the aid of numerical simulations where Discrete Element Method/Modelling (DEM) comes in. In addition to the above, everything could be formed in the particulate manner and DEM might be applied.

By these numerical methods and visualisation, many problematic issues in biosensing, monitoring, and measuring can be solved in the near future. Imagine the simulation of the blood, its components and their functions in the vessels. However there are difficulties in defining the exact shape and deformation of vessels, it is still promising to do it by simplification. Tissue engineering is viewed as the future of medicine [5], which can be one of the targets in computational simulations such as drug delivery, cell growth, and reconstruction of bone defects. In addition, stimulation of spreading of a malignant disease in the human body can help to follow and measure some parameters plus a treatment over the time. Simulation of malaria epidemiology and the impacts on that epidemiology of interventions against malaria can be prepared with such a method. With each of these, a type of estimation of some parameters of a biomater or a bioprocess is possible instead of sensing, measuring and monitoring. There are many events occurring at the same time. The biosensors can't sense all at once. Solving this is a very leading advantage of a simulation. Consequently, the advent of

***Corresponding author:** Jalal Kafashan, DEM Research Group, Division of Mechatronics, Biostatistics and Sensors, KULeuven, Belgium; E-mail: Jalal.Kafashan@biw.kuleuven.be

Received February 21, 2013; **Accepted** February 22, 2013; **Published** February 24, 2013

Citation: Kafashan J (2013) Computational Simulations: Alternative Solution in Sensing and Monitoring of Biomaterials. J Biosens Bioelectron 4: e118. doi:10.4172/2155-6210.1000e118

computational simulation has opened a new path to convert the concept of physics, biology and mathematics into reality instead of biosensing, bioelectronics and monitoring.

References

1. Schnell S, Maini PK, Newman SA, Newman TJ (2008) Multiscale Modeling of Developmental System, Academic Press.
2. Anderson ARA, Chaplain MAJ, Rejniak KA (2007) Single-Cell-Based Models in Biology and Medicine. Birkhäuser, Germany.
3. Kafashan J, Van Liedekerke P, Ramon H, Tijskens B (2011) An approach to represent realistic particles of bulk assembly in three-dimensional-DEM simulations and applications. Commun Agric Appl Biol Sci. 76: 33-36.
4. Kafashan J, Ramon H, Tijskens B (2009) Particulate Materials Simulations and Applications in Engineering Domains. Multidisciplinary Academics Symposium. London, UK.
5. Fisher JP, Mikos AG, Bronzino JD (2007) Tissue Engineering. CRC Press (Boca Raton).