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BIOSMART – Optimization Software for Biomaterial Packaging of Food

Topic: Industry, Production and Logistics, Energy and Environment



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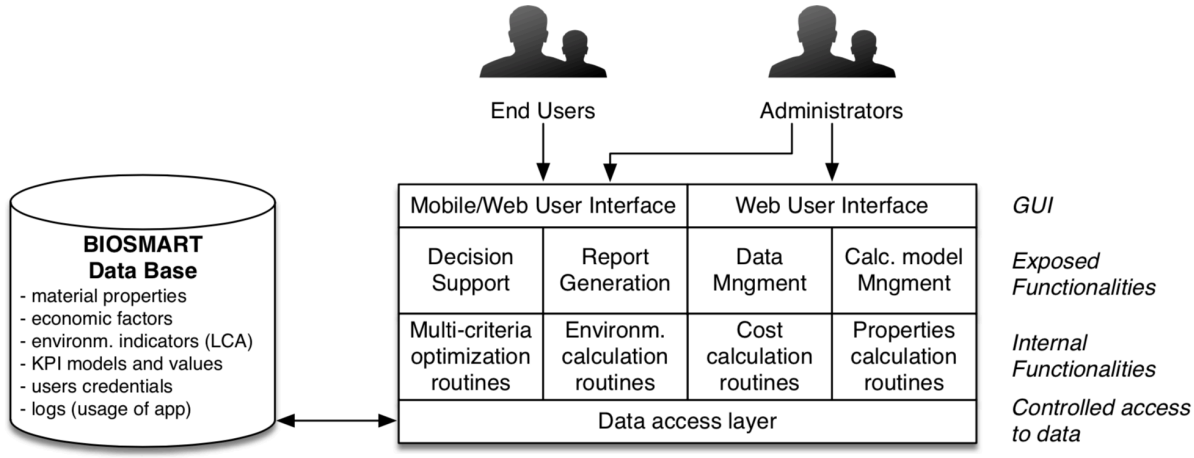
The annual plastic production follows an increasing trend. In 2016, it was around 335 million tonnes. From this quantity, roughly 40% goes into packaging [1], for which a large part is simply not recycled. Mismanagement of plastic waste typically leads to its accumulation in the oceans, with significant impacts on the ecosystem [2][3]. We are currently involved in the EU BIOSMART project targeting bio-based polymers as alternative to plastic packaging. As computer science partner in the project, our role is to develop software solutions to help scientist designing new packaging solutions using bio-based alternatives. A planned extension of our work is also to build a mobile application to help consumers finding the proper way of disposing food packaging.

A food package is a complex structure not only offering specific physical properties such as brittleness, tensile strength but also sufficient barrier properties to protect the food against oxygen, carbon dioxide, water and ultra-violet light. A traditional food package is typically composed of a set of superposed layers with different properties. The packaging is, in the end, difficult to recycle because we either lack the technology to separate the different layers and/or it is economically not viable. The goal of the EU BIOSMART project is to create new and smart solutions for food packaging, that are made from biological sources and/or are biologically degradable. A biodegradable package would have the advantage of being easier to dispose with less environmental impact.

As illustrated in the Figure below, an important piece of our development is a database that holds polymers and their properties such as density, cost, transmission rates of oxygen-, carbon dioxide- and water vapour and other physical properties which are essential when designing multi-layer food packaging. The properties give an indication of industrial factors in addition to the effectiveness of the packaging to keep the contained food in a desirable condition. A packaging is composed of layers and each layer is defined by its thickness and the material or polymer. With these parameters, a cost per square meter is calculated.



Further, some physical properties are estimated, such as transmission rates of oxygen, carbon dioxide and water vapour.

An important interest of the industrial partners is in the multi-criteria optimization routines that we are currently developing. A typical target is to minimize the cost per square meter of a package while respecting the constraints of pre-set transmission rates. The transmission rates are important in packaging as they give an indication of shelf-life of the food product. Usually, there is no global best solution for such multi-objective optimization and a set of points needs to be found that fit the user set constraints [4]. An option we are investigating is to compute the set of *Pareto optimal* points, letting the user take the ultimate decision.

An important future development of our application is the computation of environmental impact factors that will help to compare plastic packaging and more bio-friendly versions. Such environmental factors will also enter in the optimization routines to propose bio-packaging alternatives that should meet all the pre-set constraints of the original package, have a smaller environmental impact factor and be economically competitive.

Another way of tackling the ever-growing plastic waste problem is through the education of consumers. Currently, most consumers are unaware of the correct way to dispose their food packaging. We are also planning for the development of a mobile application allowing to scan a product barcode and to display information about the different package designs and polymers and their correct disposal.

[1] PlasticsEurope Market Research Group (PEMRG) and Conversio Market & Strategy GmbH (2016)
[2] Jambeck, Jenna R., et al. "Plastic waste inputs from land into the ocean." *Science* 347.6223 (2015): 768-771
[3] Law, Kara Lavender, et al. "Plastic accumulation in the North Atlantic subtropical gyre." *Science* 329.5996 (2010): 1185-1188
[4] Marler, R., et al. "Survey of multi-objective optimization methods for engineering." *Structural and multidisciplinary optimization* 26.6 (2004): 369-395

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