Mechanical Engineering
UNIVERSITY OF CALIFORNIA, BERKELEY

Department of Mechanical Engineering

Russell Severance Springer Colloquium

presents

"The Mechanics and Mathematics of Biological Growth"

Prof. Alain Goriely

Statutory Chair of Mathematical Modeling at the Mathematical Institute
University of Oxford

Wednesday, April 20, 2022
2:00 PM
3110 Etcheverry Hall

Via ZOOM: https://berkeley.zoom.us/j/95721081399
Meeting ID: 957 2108 1399

ABSTRACT

Growth is involved in many fundamental biological processes such as morphogenesis, physiological regulation, and pathological disorders. It is, in general, a process of enormous complexity involving genetic, biochemical, and physical components at many different scales and with complex interactions. In this talk, I will consider the modeling of growth in biological materials and investigate its mechanical consequences. I will show through a series of examples, how growth affects the geometry of a body by changing typical length scales but also its mechanics by inducing residual stresses. The competition between these two effects can be used to regulate the properties of organs during regular physiological conditions. It can also lead to interesting spontaneous instabilities in growing materials observed both in simple physical systems and in morphogenesis.

This talk will be aimed at a general audience and will be an introduction to the topic followed by a series of four, more or less self-contained, talks discussing the shape, mechanics, and motion of biological and physical systems with active processes or subject to residual stresses. Examples will range from plants to planets and include brains, seashells, and the chameleon tongue, among many other fascinating or quirky examples.

BIOGRAPHY

Shortly after receiving his Ph.D in mathematical physics from the University of Brussels in 1994, Alain Goriely joined the Department of Mathematics at the University of Arizona where he established a research group within the renowned Program of Applied Mathematics. He joined the University of Oxford as the Chair of Mathematical Modelling in 2010. Currently, he is the director of the Oxford Centre for Industrial and Applied Mathematics, and of the International Brain mechanics and Trauma Lab. At the scientific level, he is an applied mathematician with broad interests in mathematics, science, and engineering. His research in mathematical methods, nonlinear dynamics, and theoretical mechanics has led him to collaborate closely with scientists from many other disciplines such as engineering, biology, medical sciences, chemistry, and physics. His current research includes the mechanics of biological growth and its applications to plants and physiology; the multiscale modelling of the brain, the mathematical foundations of elasticity; the dynamics of curves, knots, and rods, and the development of mathematical methods for applied sciences. He is the author of *Integrability and Nonintegrability* (2011), *The mathematics and Mechanics of Biological Growth* (2017), and of *Applied Mathematics: A Very Short Introduction (2018).*

Hosted by: Professor Oliver M. O'Reilly, 5131 Etcheverry Hall, 510-642-0877, oreilly@berkeley.edu

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Department of Mechanical Engineering
Russell Severance Springer Lecture Series
presents

Professor Alain Goriely
Statutory Chair of Mathematical Modeling at the Mathematical Institute
University of Oxford

April 26, May 5, 10 and 12
2:00 PM
3110 Etcheverry Hall

Via ZOOM: https://berkeley.zoom.us/j/95721081399
Meeting ID: 957 2108 1399

The Mechanics and Mathematics of Biological Growth

Growth is involved in many fundamental biological processes such as morphogenesis, physiological regulation, and pathological disorders. It is, in general, a process of enormous complexity involving genetic, biochemical, and physical components at many different scales and with complex interactions. In this talk, I will consider the modeling of growth in biological materials and investigate its mechanical consequences. I will show through a series of examples, how growth affects the geometry of a body by changing typical length scales but also its mechanics by inducing residual stresses. The competition between these two effects can be used to regulate the properties of organs during regular physiological conditions. It can also lead to interesting spontaneous instabilities in growing materials observed both in simple physical systems and in morphogenesis.

DATES	**TOPICS**
April 26	The Shape and Mechanics of Active Filaments with Applications to Neurons and Plants
May 5	The Shape and Mechanics of Surfaces with Application to Shells and Skulls
May 10	The Shape and Mechanics of the Growing Brain
May 12	The Shape and Mechanics of Gravitating Moons and Planets

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