BIRZEIT UNIVERSITY

Faculty of Science كلية العلوم

Department of Physics دائرة الفيزياء

The Department of Physics

Invites you to attend a lecture on

Computational Multiphysics - from Liquid Crystals to Multiphase Flows

Presented by

Dr. Nasser Abukhdeir
from University of Waterloo, Canada

On

Tuesday 19-2-2019 at 15:15 –16:30

Faculty of Science Building – SCI240

Abstract & bio attached

Multidisciplinary Research using Computational Multiphysics - from Liquid Crystals to Multiphase Flows

Computational multiphysics (CMP) is the study of processes with multiple coupled physical and chemical phenomena through the numerical solution of mathematical models. Multiphysics processes are typically studied using continuum methods enabling access to length and time scales relevant to both experimental and industrial research. Research and development which leverage CMP methods have two key advantages compared to tradition approaches: adaptability of application and low resource requirements.
The former advantage (adaptability) is highlighted in this presentation using, as examples, my research group activities: fundamental study of the dynamics of liquid crystal (LC) phases and applied/industrial research on multiphase flows.

Focusing on the dynamics of LC phases, over the past several decades many disruptive technological advancements have been made through the use of LC materials including liquid crystal displays (LCDs), high performance polymers (Kevlar, Vectran), tunable lasers, and adaptive optical lenses. The majority of these applications utilize the most simple class of LC phases (nematics) under conditions precisely engineered to suppress nanoscale LC phenomena such as defect formation and dynamics. Continued advancement of LC-based technology requires that we leverage these nanoscale phenomena instead of suppressing them. Simulation-based design is a key enabler in that simulations are able to capture both characteristic (nano) and device (macro) scales which is infeasible through traditional experimentation alone.

Focusing on multiphase flows, these are present in a broad range of industrial processes from bioreactors for vaccine production to fluidized bed reactors for refining crude oil. Computational fluid dynamics (CFD) simulations are widely used in order to predict multiphase hydrodynamic behaviour due to its complexity and challenges in experimental characterization. While CFD simulations have been demonstrated to be predictive for a range of single-phase flow conditions, multiphase flows introduce significant challenges both theoretically and numerically. These challenges must be addressed in order to advance multiphase CFD simulations to be truly predictive for processes of interest.

While different from a physicochemical perspective, both CMP-related research areas have commonalities in the use of continuum mechanics and similar numerical methods for simulation. These common foundations enable CMP researchers to transition between fundamental, applied, and industrial research to adapt to an ever-changing world.

About the speaker:

Dr. Abukhdeir is an Associate Professor of Chemical Engineering, cross-appointed in Physics and Astronomy, at the University of Waterloo (Waterloo, Canada).

He completed his BS and MChE at Carnegie Mellon University (Pittsburgh, USA) and his PhD at McGill University (Montreal, Canada) under the supervision of Prof. Alejandro Rey. His research group is focused on industrial and fundamental research on processes involving soft matter, phase transitions, complex fluids, .and multiphase flows

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