Modeling coupled systems of multiphase fluids and solids using phase fields

Jesus Bueno[1], **Yuri Bazilevs**[2], **Hector Gomez**[3]

[1]Universidade da Coruña,
School of Civil Engineering,
Campus de Elviña, s/n, 15192 A Coruña, Spain
jesus.bueno@udc.es
[2]University of California San Diego
Department of Structural Engineering,
9500 Gilman Drive, 92093 La Jolla, CA, USA
yuri@ucsd.edu
[3] Purdue University,
School of Mechanical Engineering,
585 Purdue Mall, 47907 West Lafayette, IN, USA
hgomezgomez@purdue.edu

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There is a large body of literature dealing with the interaction of solids and classical fluids, but the interaction of solids and multiphase fluids remains practically unexplored, at least from the computational point of view.

Multiphase fluids produce much richer physics than classical fluids when they interact with solids, especially at small scales. In this presentation, I will illustrate this point by studying several physical phenomena in which the interaction of multiphase fluids and solids plays a key role, such as, for example, phase-change-driven implosion [1], capillary origami [2], and the sessile drop experiment on soft surfaces [2,3]. I will also present a new bioinspired mechanism for droplet motion in deformable substrate termed tensotaxis [4].

From a methodological point of view, I will use a phase-field model to describe the complex fluid, and classical nonlinear hyperelasticity to model the solid. Our computational framework is based on Isogeometric Analysis [5], which allows for a straightforward discretization of the higher-order partial differential operators typically present in multiphase flow theories based on the phase-field method.

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