

## Accepted Manuscript

PFEM formulation for thermo-coupled FSI analysis. Application to nuclear core melt accident

Alessandro Franci, Eugenio Oñate, Josep Maria Carbonell,  
Michele Chiumenti



PII: S0045-7825(17)30114-7  
DOI: <http://dx.doi.org/10.1016/j.cma.2017.07.028>  
Reference: CMA 11530

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date : 17 January 2017  
Revised date : 25 July 2017  
Accepted date : 27 July 2017

Please cite this article as: A. Franci, E. Oñate, J.M. Carbonell, M. Chiumenti, PFEM formulation for thermo-coupled FSI analysis. Application to nuclear core melt accident, *Comput. Methods Appl. Mech. Engrg.* (2017), <http://dx.doi.org/10.1016/j.cma.2017.07.028>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

PFEM formulation for thermo-coupled FSI  
analysis. Application to nuclear core melt  
accident.

Alessandro Franci<sup>\*1,2</sup>, Eugenio Oñate<sup>1,2</sup>, Josep Maria  
Carbonell<sup>1,2</sup>, and Michele Chiumenti<sup>1,2</sup>

<sup>1</sup> International Center for Numerical Methods in Engineering  
(CIMNE)

<sup>2</sup> Universitat Politècnica de Catalunya (UPC)  
Gran Capitán s/n, Campus Norte UPC, 08034 Barcelona, Spain

July 29, 2017

**Abstract**

The aim of this paper is to present a Lagrangian formulation for thermo-coupled fluid-structure interaction (FSI) problems and to show its applicability to the simulation of hypothetical scenarios of a nuclear core melt accident. During this emergency situation, an extremely hot and radioactive lava-like material, the corium, is generated by the melting of the fuel assembly. The corium may induce collapse of the nuclear reactor devices and, in the worst case, breach the reactor containment and escape into the environment. This work shows the capabilities of the proposed formulation to reproduce the structural failure mechanisms induced by the corium that may occur during a meltdown scenario. For this purpose, a monolithic method for FSI problems, the so-called Unified formulation, is here enhanced in order to account for the thermal field and to model phase change phenomena with the Particle Finite Element Method (PFEM). Several numerical examples are presented. First, the convergence of the thermo-coupled method and phase change algorithm is shown for two academic problems. Then, two complex simulations of hypothetical nuclear meltdown situations are studied in 2D as in 3D.

---

\*email: falessandro@cimne.upc.edu

Download English Version:

<https://daneshyari.com/en/article/4963810>

Download Persian Version:

<https://daneshyari.com/article/4963810>

[Daneshyari.com](https://daneshyari.com)