ICRAMCS 2026
THE EIGHTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE
April 23-24-25, 2026 | Marrakech, Morocco

Optimal Control Approach for Bilateral Elastic Contact Problem with Power-Law

Communication Info

Authors:
Oumaima ATELAUE[1]
Zakaria FAIZ[2]
Rachid BOUCHANTOUF[3]
Hicham BENAISSA[4]

[1] *Sultan Moulay Slimane University, FP Khouribga, Morocco.*
[2] *Mohammed First University, FP Nador, Morocco.*
[3] *Sultan Moulay Slimane University, FP Khouribga, Morocco.*
[4] Sultan Moulay Slimane University, FP Khouribga, Morocco.

Keywords:
(1) Optimal control approach
(2) multivalued equation
(3) Clarke subdifferential

Abstract

This paper develops a variational optimal control framework to analyze a bilateral elastic contact problem with power-law friction, where non-penetration conditions and nonlinear friction are modeled via the Clarke subdifferential of a nonsmooth potential energy functional, following the hemivariational inequality theory of [1,2]. Reformulating the problem as a nonlinear multivalued inclusion $f \in Fy+\partial\Phi(y)$ in a Hilbert space, we establish the existence and uniqueness of a weak solution using abstract results from dynamic inclusion theory, extending techniques for elliptic variational inequalities [3]. The optimal control approach—inspired by energy-based schemes in [4]—minimizes a global functional, reducing high-order PDEs to tractable lower-order systems while enhancing solution regularity, a critical step for numerical implementation. The model generalizes classical Coulomb friction via power-law regularization, a technique validated for granular materials and soft tissues, broadening applicability to industrial processes like metal forming or biomechanics. By bridging variational analysis, contact mechanics, and control theory, this work advances theoretical and computational tools for complex contact problems, offering a flexible foundation for future simulations in solid mechanics .

 ISSN: 2605-7700

References

[1] P.D. Panagiotopoulos, Inequality problems in mechanics and applications. Birkhauser, Boston, 1985.
[2] P. D. Panagiotopoulos, Hemivariational inequalities, applications in mechanics and engineering. Springer-Verlag, Berlin, 1993.
[3] N. Kikuchi and J.T. Oden, Contact problems in elasticity: a study of variational inequalities and finite element methods. SIAM, Philadelphia, 1988.
[4] P. Neittaanmaki, J. Sprekels, and D. Tiba, Optimization of elliptic systems: theory and applications. Springer-Verlag, New York, 2006.