

# ICRAMCS 2026

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



## Deep Learning Methods for Mean-Field-Type Stochastic Control Problems

### Communication Info

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#### Keywords:

(1) Stochastic control

(2) Mean-field SDE

(3) Deep learning

### Abstract

We study high-dimensional optimal control problems driven by a mean-field-type stochastic differential equation (SDE) [1] from the perspective of the stochastic maximum principle to derive necessary and sufficient optimality conditions. We show that these mean-field-type stochastic control problems can be efficiently solved using deep neural networks [2]. By introducing an extended Hamiltonian system, which consists of a forward-backward stochastic differential equation (FBSDE) [3] whose coefficients depend on both the state of the solution process and its expected value, together with a maximum condition, we reformulate the original control problem as an equivalent variational problem. To solve this reformulated problem, we develop three neural network-based algorithms. Numerical results demonstrate the effectiveness and robustness of our approaches. In particular, we present illustrative examples based on the optimal mean-variance portfolio problem [4].

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