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Dynamic Risk Control in Banking Operations Using Physics-Informed Neural Networks

Communication Info

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Abstract

In this work, we propose a new framework for developing a dynamic control for the banking industry that uses Physics-Informed Neural Networks (PINNs) to model the relationships among the different operational layers of banking systems. The banking architecture is divided hierarchically and consists of a client base consisting of banks' assets (loans) or liabilities (deposits) processed through the front office (service and transaction processing) supervised by the middle office (monitoring, reporting and managing risk) and finalized in the back office (account/deposit settlement). The risk management layer closes the control system by providing feedback and strategic corrections.

The financial flows between these operational layers will be modeled as a system of coupled ordinary differential equations to capture the dynamics within liquidity, transaction volume, and risk through time. We incorporate a control variable that represents the risk-adjusted intervention, allowing for real-time adjustments and compliance with regulations. Instead of using only classical numerical methods, we use PINN to approximate the solution of this controlled dynamical system. PINNs are able to directly incorporate the governing differential equations into its loss function for the model so that it can learn system dynamics while meeting financial constraints and maintaining stable conditions.

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