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Control Problems in Online Advertising and Benefits of Randomized Bidding Strategies

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Abstract

Online advertising is a US\$600 Billion industry where feedback control has come to play a critical role. The control problems are challenging and involve nonlinearities including discontinuities, high dimensionality, uncertainties, non-Gaussian noise, and more. In this paper systems engineering principles are applied to a core optimization problem within online advertising. First we demonstrate how the optimization problem may be decomposed into separate low-level estimation and high-level control modules. Then we derive a plant model from first principle to show how uncertainties and noise propagate through the plant. The plant model reveals challenges of the control problem and provides a framework to assess the impact on the plant behavior from different designs of the low-level estimation module. Thereafter, we describe a bid randomization technique that can be used in various ways to improve the performance and robustness of the system. The bid randomization technique is finally used to develop an algorithm for exploration and exploitation of an auction-based network, furnishing a solution to the above estimation subproblem.

Keywords: advertising, optimization, modeling, bidding, randomization, exploration and exploitation

1. Introduction

1.1. Overview

Over the past decade, the online advertising industry has grown dramatically in size, significance, and complexity; and an ever-growing number of

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