A Near Optimal Bidding Strategy for Real-Time Display Advertising Auctions

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This paper introduces a near optimal bidding strategy for use in real-time display advertising auctions. These auctions constitute the dominant distribution channel for internet display advertising and a potential funding model for addressable media. The problem is modelled as a dynamic competitive game with incomplete information. For each auction, the focal advertiser has knowledge of only their valuation of the impression and the remaining campaign budget. The cost of the impression is revealed only if they win the auction. Under fairly generic assumptions on the distribution of auctions, an efficient, implementable learning algorithm is presented. Off equilibrium, this algorithm is proven to rapidly converge to the best response strategy. Further, it achieves zero-regret with respect to a strategy with perfect foresight of all future valuations and competing bids. The existence and uniqueness of a competitive equilibrium is established. It is further shown that all the advertisers converge to this equilibrium when they simultaneously employ the proposed learning algorithm.

Across a series of 100 simulated and ten real-world campaigns, the algorithm delivers 98% of the value achievable with perfect foresight and outperforms the best available alternative by 11%. The approach is then generalized to allow impression values and costs to evolve over time. Even when these underlying attributes change rapidly, the algorithm delivers 76% of the value achievable with perfect foresight and outperforms competing alternatives by 33%. This work contributes to marketing literatures on the design and use of decision support systems and the impact of internet display advertising.

Key words: Online Advertising, Internet Display Advertising, Stochastic Optimization, Sequential Auctions, Bidding Strategies