

Learning Bid Shading in First-Price Auctions via Measure-Valued Optimization

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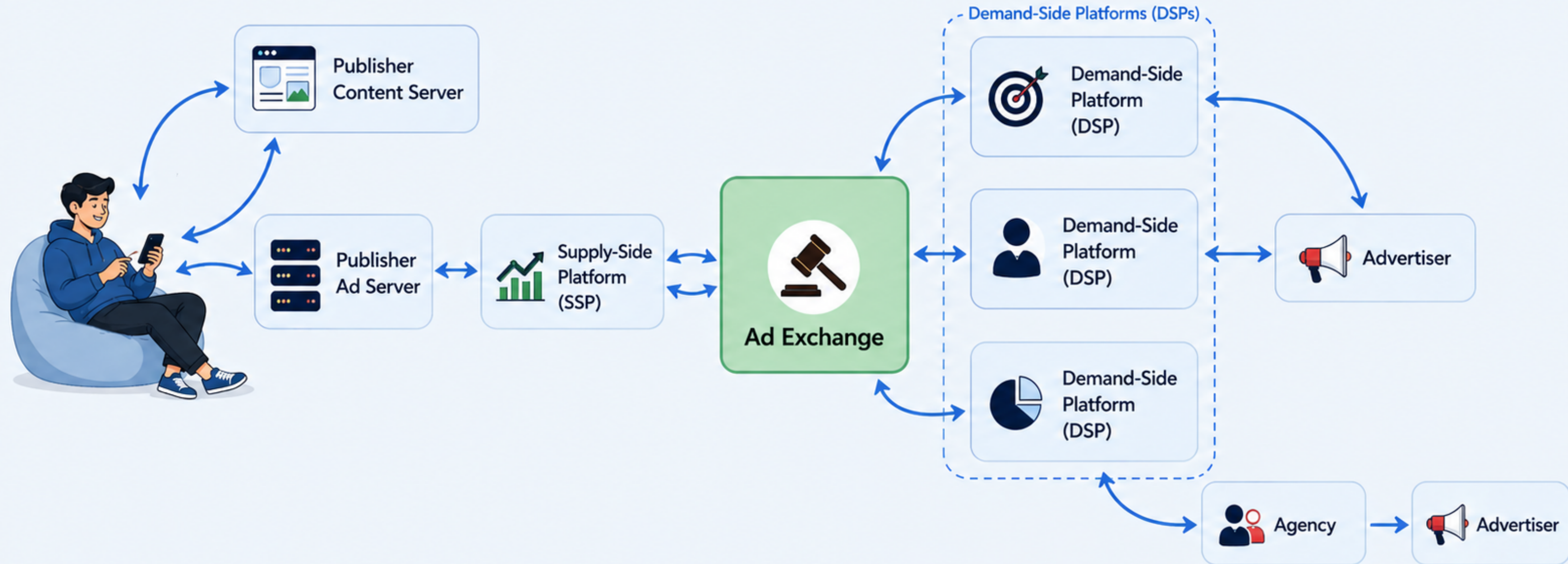


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How Online Ads Work

A simple look at the journey of an ad from advertiser to you.



The Speed of Online Ads

Milliseconds matter.



Human blink

~300 ms

That's how long it takes.



Hummingbird

~20x

Flaps its wings about 20 times in that same blink.



Ad Tech (DSP)

~300,000

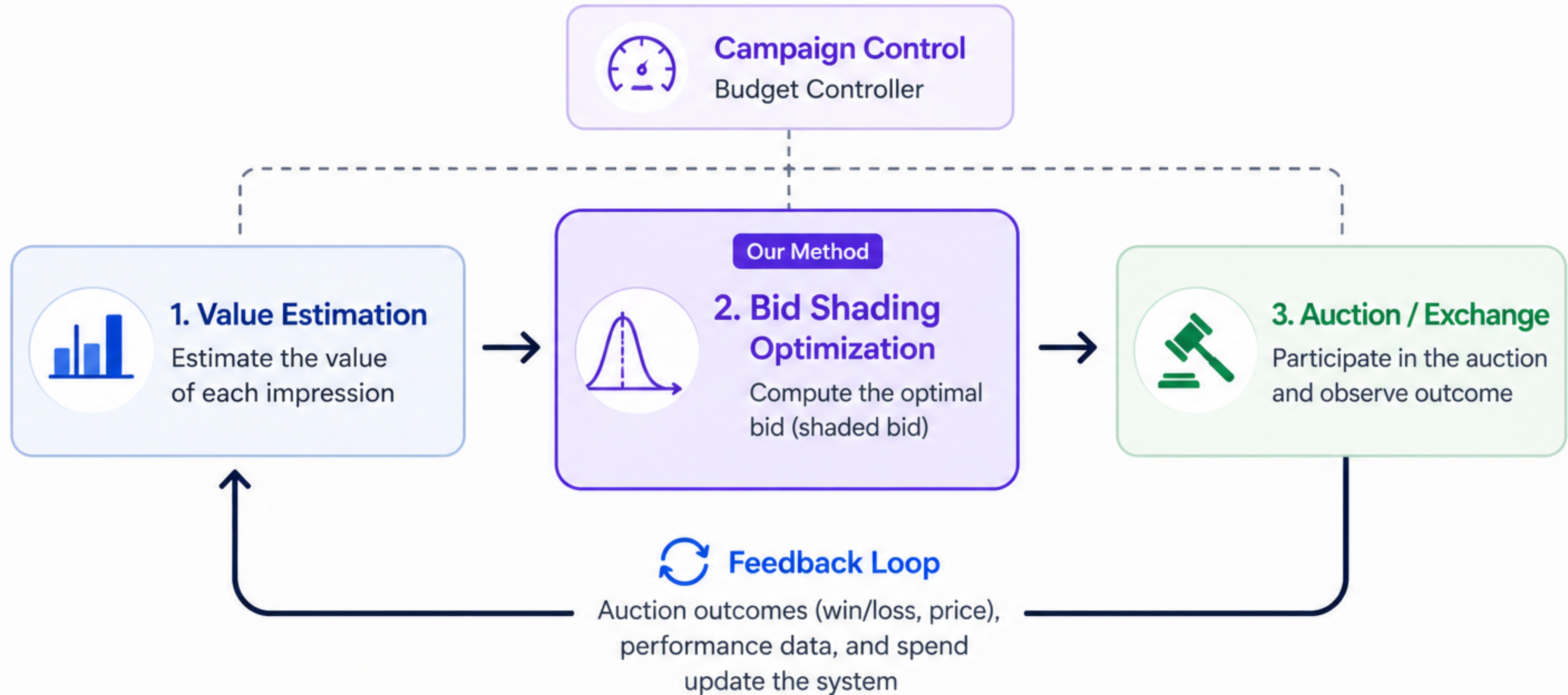
Bidding decisions on ad opportunities in that time.



All of this happens **before** the page loads.

Closed-Loop Bidding System (DSP)

Make the **right bid**, learn from every auction, and **improve** every time.



Bidding is a closed-loop learning problem — **decisions are continuously updated from auction feedback.**

From Single Bid to Distribution Learning

We learn a **distribution** of bid parameters and update it using **Wasserstein** geometry.

Existing Approach

(Single Parameter)



Our Approach

(Distribution over Parameters)



Our update moves probability mass toward better bids while staying close to the previous distribution.

✓ Respects geometry (Wasserstein distance)

✓ Stable & smooth updates

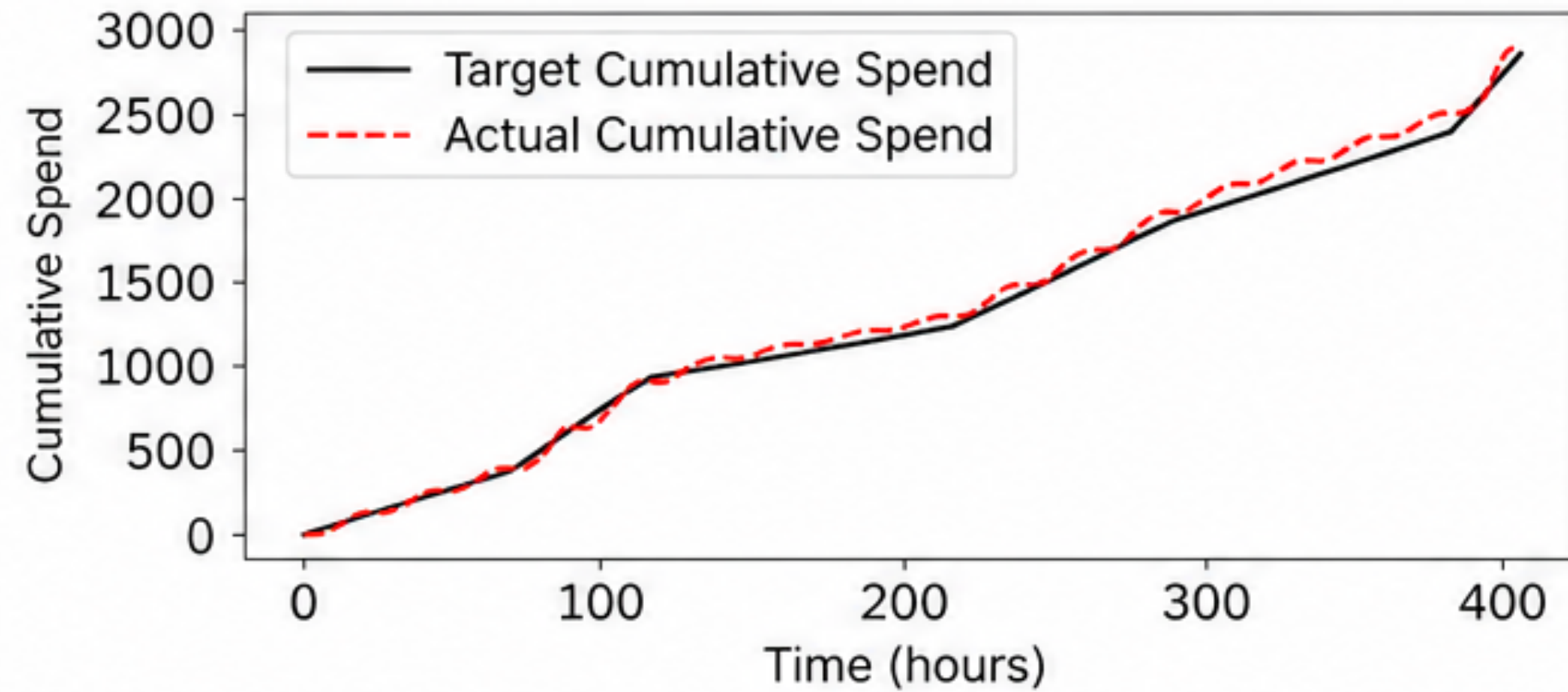
✓ Efficient closed-form update ($\mathcal{O}(N^2)$)

- High surplus (good)
- Medium
- Low (bad)
- Probability mass

Simulation Results

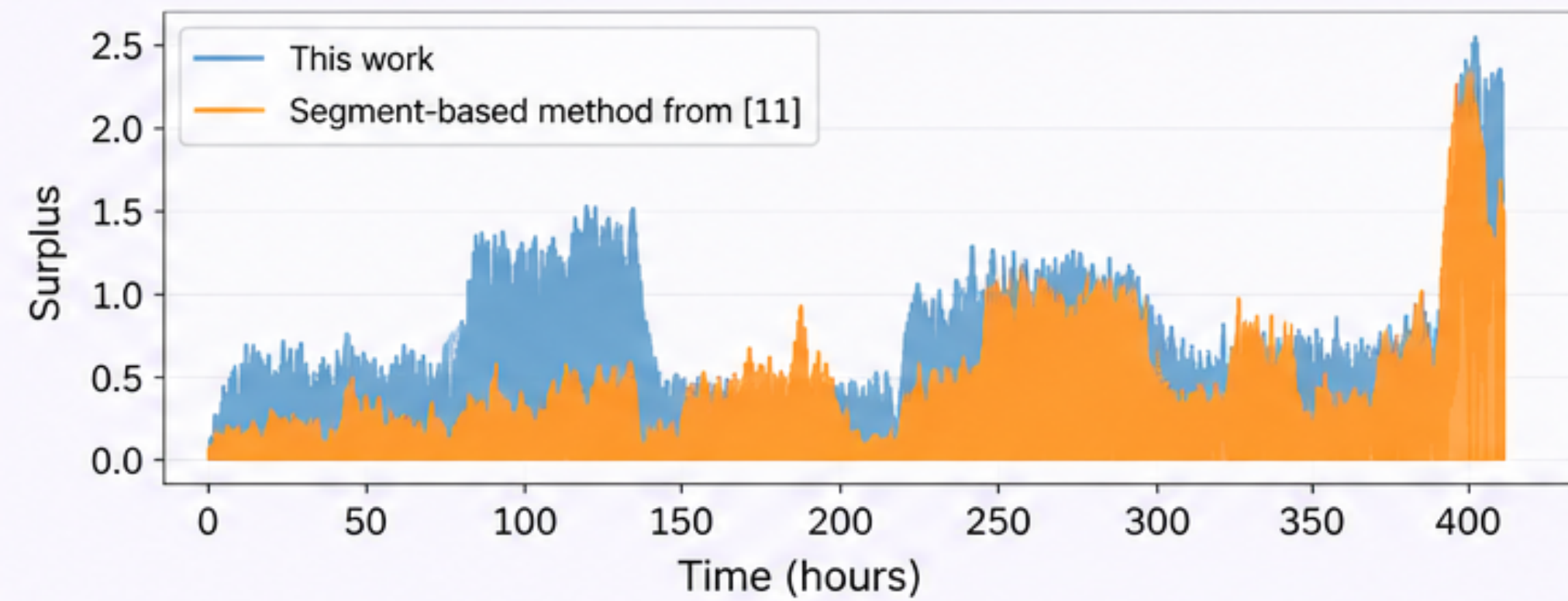
Dynamic environment (changing budgets & seasonality). Our method *learns, adapts, and delivers higher value*.

1 Budget Tracking



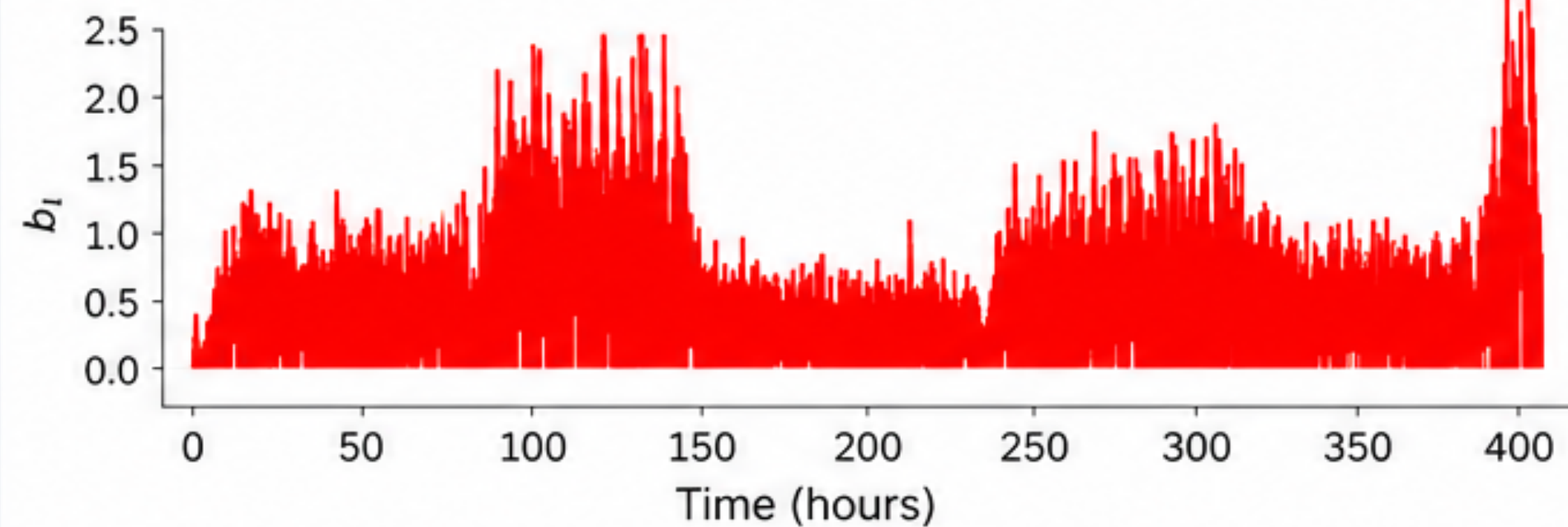
✓ Tracks target spend closely

2 Higher Surplus



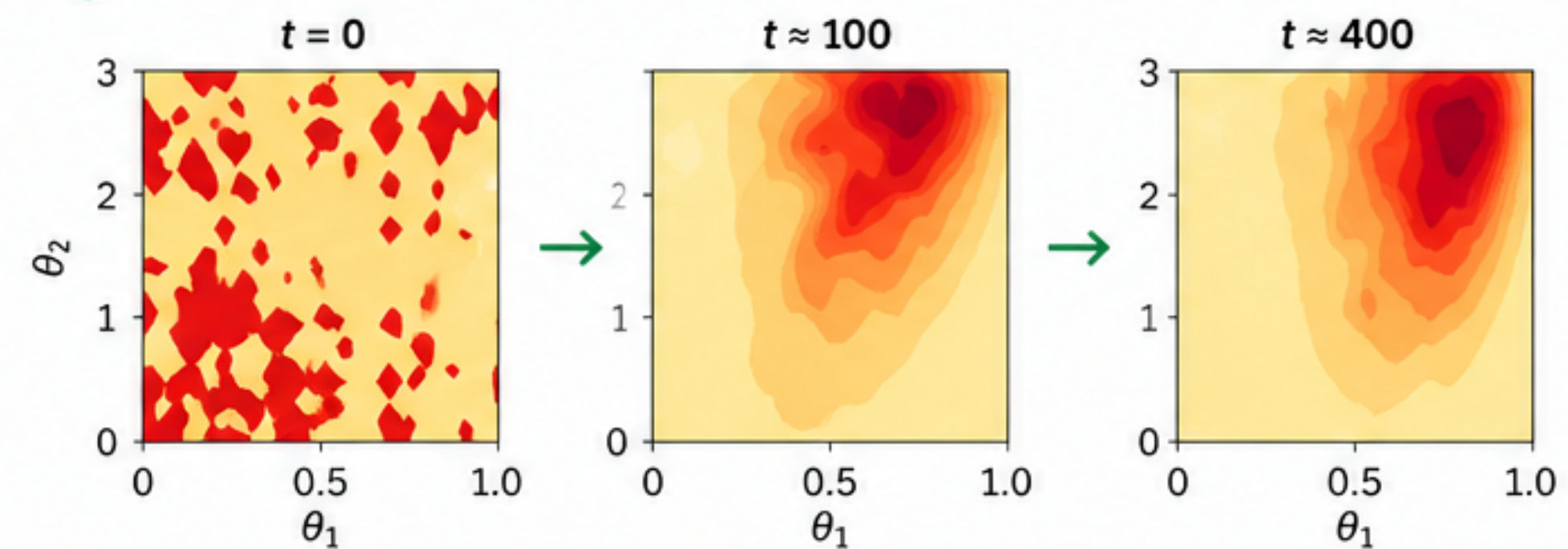
★ Outperforms baseline

3 Adaptive Bidding



✓ Responds to market & budget changes

4 Learning Where to Bid



✓ Concentrates on high-value regions



Learns → Adapts → Tracks budget → Improves profit

Thank You!

Questions?

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