MEV Capture Through Time-Advantaged Arbitrage

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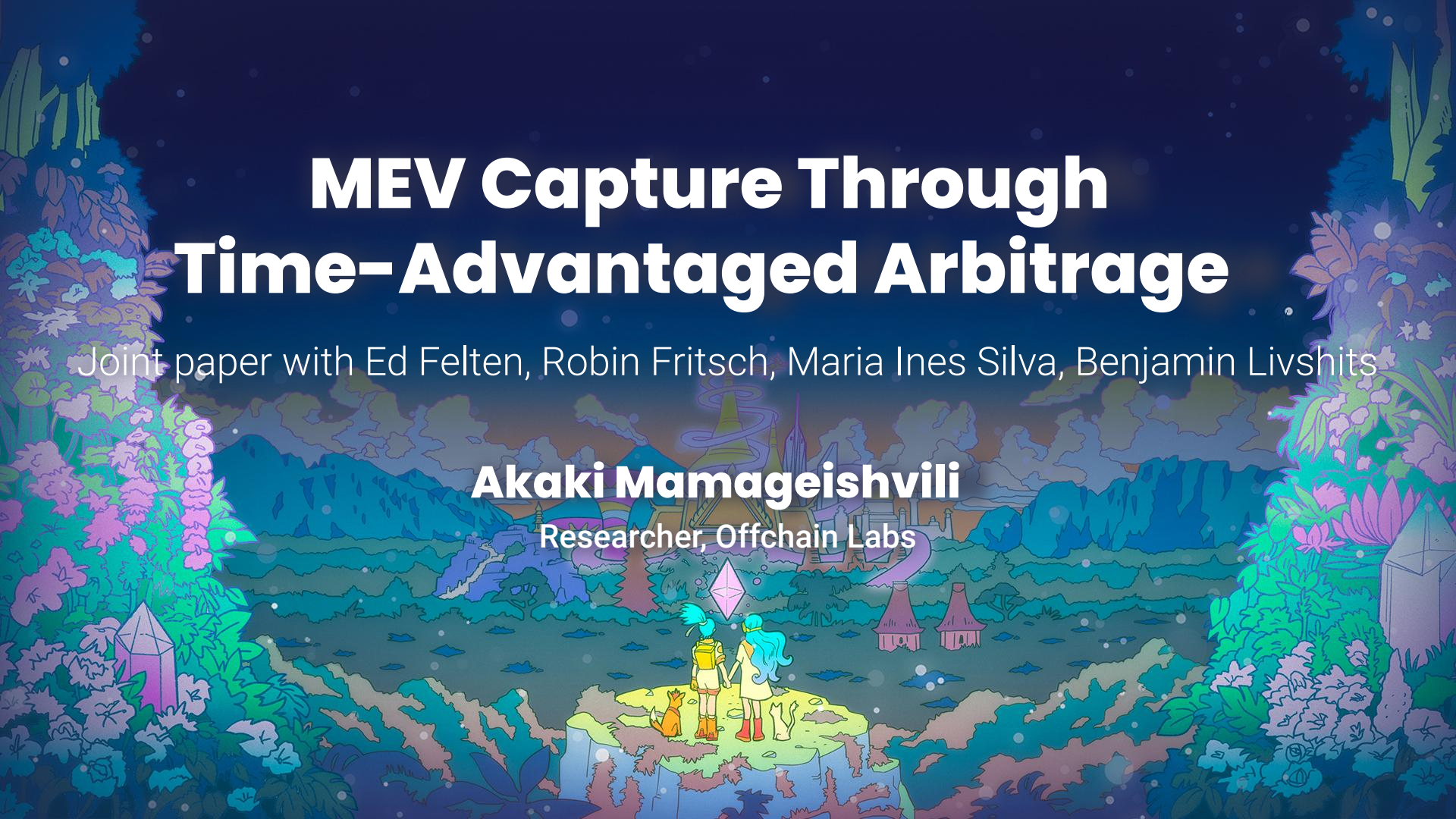

Section 1

Motivation

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TimeBoost fast lane license:

- one player has 200ms advantage over others
- advantage lasts for 1 minute

Advantage is achieved by delaying all transactions of other users by 200ms

We look into Automated Market Makers deployed on Arbitrum

- potential arbitrage profits that can be extracted with time edge
- arbitrage trades between an AMM pool and an external venue
- the external venue: the entire outside market

Assumptions

The price impact of trading on the external venue is negligible

- the external venue is assumed to have significantly larger liquidity

Price discovery for the risky asset takes place on the external market

Ignore uninformed (non-arbitrage, “noise”) trades on the AMM

The risky asset’s external price follows a memoryless process

- future price changes are independent of past prices

Section 2

Model

Model

- One actor has a time advantage over everybody else during given time period T
- Trades between two assets – a risky asset and a numeraire
- An AMM pool has a trading fee
- The risky asset's external market price changes over time
- Initially, the prices on the AMM and the external market prices are assumed to be equal
- When an arbitrage opportunity arises, arbitrageur decides when to capitalize
- Other arbitrageurs can also detect these opportunities
- During advantage time no arbitrageur can interact with the AMM to react
- Opportunities not exploited within advantage time will be exploited by others

Section 3

Optimization Problem

Dynamic Programming Solves It

Decision Problem

The time-advantaged arbitrageur decides whether to execute an arbitrage trade or wait based on:

- the current price difference p
- the elapsed time within their advantage window
- the elapsed time t within the overall period T

Determine the optimal strategy for this decision and the resulting profits

Section 4

Simulation Results

Simulation Results

Numerically compute the optimal strategy for different distributions of the price change

- step size: Δ=10 ms
- advantage window: 200 ms
- total time: T=1 min

The function can be computed using dynamic programming:

- values for $t = T - \Delta$ can be computed using the values for $t = T$, and so on

Waiting Till the End is (mostly) Optimal

The model allows to compute upper bound on CEX–DEX arbitrage value for time advantaged party

Value distribution between LPs, time advantaged arbitrageur, and others by letting pool contract know about TimeBoosted transactions