Bubbly Finance: An Automated Market Maker for Standard Futures [Draft]

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ABSTRACT

Bubbly Finance is a standard futures trading protocol. By leveraging the Margin Liquidity Market Makers (MLMM) model and concentrated liquidity, it provides high capital efficiency and fine-tuned control to liquidity providers. Any asset with a clear expiration time can establish its on-chain market on top of Bubbly Finance.

1 INTRODUCTION

Innovations in DeFi are vast, but one pivotal moment from zero-to-one was the introduction of Automated Market Makers (AMM) [4]. Most AMM (Automated Market Maker) mechanisms are mostly implemented for spot trading scenarios.

Uniswap [1, 2] implemented an automated liquidity protocol based on a "constant product formula", the pair stores pooled reserves of two assets, and provides liquidity for those two assets, maintaining the invariant that the product of the reserves cannot decrease.

In Uniswap v3 [3], liquidity providers (LPs) are given the ability to concentrate their liquidity by "bounding" it within an arbitrary price range. This improves the pool's capital efficiency and allows LPs to approximate their preferred reserves curve, while still being efficiently aggregated with the rest of the pool.

Virtual Automated Market Makers (vAMM) borrows the price discovery mechanism of spot AMM, adding leveraged trading and long/short position opening and closing scenarios. As a result, vAMM is widely used in on-chain perpetual contract scenarios.

However, attempts to apply AMM to standard futures with physical deliveries have been scarce. Standard futures are essentially margin trades where both buyers and sellers commit margin to either go long or short on a particular asset.

Bubbly Finance has innovated a new futures trading model, the Margin Liquidity Market Makers (MLMM). It combines the characteristics of both spot AMM and vAMM in its price discovery mechanism. It utilizes a dual-collateral model for margin management and includes functionalities for adding liquidity based on margins and bi-directional opening and closing of positions.

In Bubbly Finance, we provide following notable features:

- *Margin trading*: Bubbly Finance utilizes underlying assets as margins to represent the positions of traders and liquidity providers. Considering that one side of the asset may not yet be properly issued on-chain in the trading scenarios served by MLMM, all asset settlements in this protocol are conducted using margins.
- *Reverse trading*: Bubbly Finance allows anyone to long or short the specific asset with margins. Under the AMM mechanism in spot trading, it is not possible to short assets. MLMM achieves the functionality of opening and closing long and short positions without leverage based on the AMM mechanism.
- *Recycling liquidity*: Bubbly Finance maximizes the capital efficiency for the liquidity providers. When liquidity providers add single-sided liquidity, the amount of margin they pay should match the value of the single-sided assets. If liquidity providers add both sides of liquidity, MLMM will automatically calculate the minimum margin amount required and these margins can be reused as both sides of passive tradings.

The following sections provide in-depth explanations of these features and the technical designs that help make them possible.

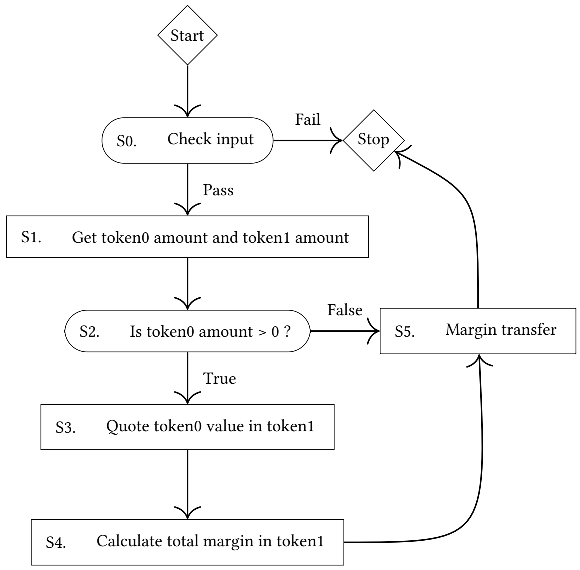

Figure 1: Add Liquidity Flow

2 MARGIN LIQUIDITY MARKET MAKERS

In Bubbly Finance, MLMM serves as the core price discovery engine with margin liquidity management. It includes the following main calculations and management:

- Liquidity margin
- Active-trading margin
- Passive-trading margin
- Trading fee

2.1 Liquidity margin

In Bubbly Finance, token0 is the virtualized point or pre-launch token, and token1 is the quote token. The tick at which the current pool price resides is denoted as tick_c. When users add liquidity, the upper and lower tick boundaries are denoted as tick_u and tick_l, respectively. Figure1 shows the flow of adding liquidity.

- If $\text{tick}_c > \text{tick}_u$, users add single-sided liquidity on the left side of the current price, which is entirely token1. The margin needed by the LP is the amount of token1.
- If $\text{tick}_c < \text{tick}_l$, users add liquidity on the right side of the current price, which is entirely token0. The mar needed by the LP is the amount of token1 required to fully exchange token0 within the $[\text{tick}_u, \text{tick}_l]$ range.
- If $\text{tick}_u \le \text{tick}_c \le \text{tick}_l$, the added liquidity includes both token0 and token1. The liquidity within the $[\text{tick}_u, \text{tick}_c]$ range is token1, and within the $[\text{tick}_c, \text{tick}_l]$ range is token0. The margin required by the LP is the maximum value between the amount of token1 needed to exchange token0 within the $[\text{tick}_c, \text{tick}_l]$ range and the amount of token1 needed within the $[\text{tick}_u, \text{tick}_c]$ range.

Following are the calculation formulas of these parameters:

- $\Delta y'$ represents the amount of token0 required within the price range from P_l to P_c. The calculation formula is:

$$\Delta x = \left(\frac{1}{\sqrt{P_l}} - \frac{1}{\sqrt{P_c}}\right) L$$

$$\Delta y' = \text{getAmountYFromAmountX}(\Delta x)$$

- Δy represents the amount of token1 required within the price range from P_c to P_u. The calculation formula is:

$$\Delta y = \left(\sqrt{P_c} - \sqrt{P_u}\right) L$$

- Δm represents the margin amount required for providing liquidity within both price ranges. The calculation formula is:

$$\Delta m = \max(\Delta y, \Delta y')$$

2.2 Active-trading margin

Opening and closing positions essentially involve completing swap operations in the pool. Regardless of buying or selling token0, the required margin amount is the token1 equivalent to the value of the token0 in the current transaction. Figure2 shows the flow of updating position.

Following are the calculation formulas of these parameters: Δy represents the amount of token1 needed to be swapped in as margin. Δx represents the amount of token0 to buy or sell. The calculation formula is:

The contract actually tracks liquidity (L) and square root of price ($\sqrt{P}$) instead of x and y. We could compute x and y from those values, and then use those to calculate the execution price of the trade. But it turns out that there are simple formulas that describe the relationship between $\Delta\sqrt{P}$ and Δy, for a given L:

$$\Delta\sqrt{P} = \frac{\Delta y}{L}$$

$$\Delta y = \Delta\sqrt{P} \cdot L$$

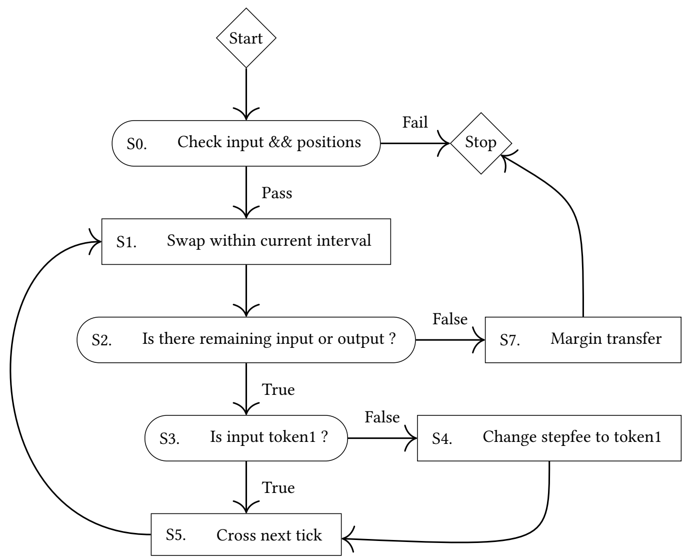

Figure 2: Position Update Flow

There are also simple formulas that describe the relationship between $\Delta\frac{1}{\sqrt{P}}$ and Δx:

$$\Delta\frac{1}{\sqrt{P}} = \frac{\Delta x}{L}$$

$$\Delta x = \Delta\frac{1}{\sqrt{P}} \cdot L$$

2.3 Passive-trading margin

During the period from when the LP adds liquidity to when it is withdrawn, tradings may cause the price of point/pre-launch tokens to change. When the price deviates from the price at which the LP added liquidity, the LP passively engages in trades as the counterparty. This results in a passive position when the LP withdraws liquidity, and the margin required for opening this position will be deducted from the LP's initial margin.

Denote the tick at the time of LP withdrawing liquidity as tick_d and at the time of adding liquidity as tick_a.

Denote the LP's initial margin amount as $\text{lp}_{\text{margin}}$ and the margin amount required for opening the position as $\text{op}_{\text{margin}}$. The amount of margin the LP can redeem when withdrawing liquidity is the difference between the amounts of these two margins. It can be calculated as following:

$$Margin_{occupied} = \left|amount1_{add} - amount1_{dec}(p)\right|$$

$$amount1_{dec}(P) = \begin{cases} 0 & P_l \geq P \\ \left(\sqrt{P_u} - \sqrt{P}\right)L & P_l < P < P_u \\ \left(\sqrt{P_u} - \sqrt{P_l}\right)L & P \geq P_u \end{cases}$$

$$Margin_{remaining} = Margin_{initial} - Margin_{occupied}$$

- If $\text{tick}_a > \text{tick}_d$, the LP passively generates a long position. When more users sell token0, the LP acts as a counterparty and passively buys token0. Upon exiting liquidity, if calculated using the standard AMM mechanism, the LP should receive more token0 and less token1. The difference between the token1 received upon exiting liquidity and the token1 initially added as liquidity represents the token1 passively occupied by the LP as the counterparty. Under the MLMM mechanism, this portion of token1 will be deducted from the LP's margin.

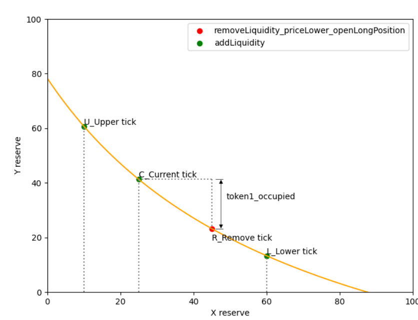

Figure 4: Passive long position

- If $\text{tick}_a \leq \text{tick}_d$, the LP passively generates a short position. When more users buy token0, the LP acts as a counterparty and passively sells token0. Upon exiting liquidity, if calculated using the standard AMM mechanism, the LP should receive more token1 and less token0. The difference between the token0 received upon exiting liquidity and the token0 initially added as liquidity represents the token0 passively occupied by the LP as the counterparty. Under the

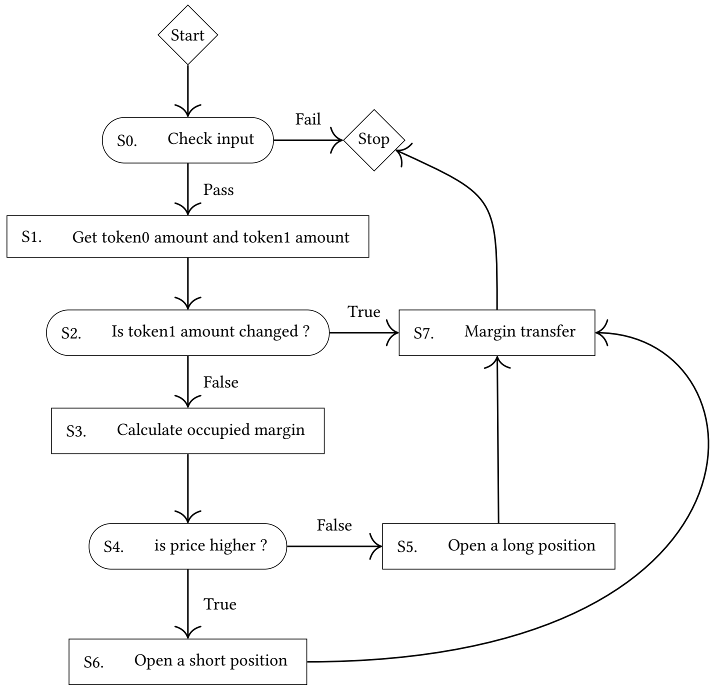

Figure 3: Remove Liquidity Flow

MLMM mechanism, this portion of token0 will be valued in quote tokens and deducted from the LP's margin.

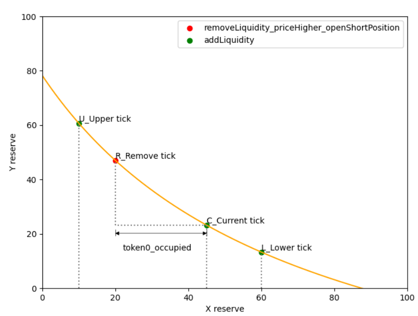

Figure 5: Passive short position

2.4 Fees

All user actions, including trading fees, are settled using a single asset. Unlike dual-asset fee calculation, single-asset fee calculation eliminates the user's exposure to multi-asset risks (such as the depreciation of the non-stablecoin asset used for fees). Fee calculation in single step can be processed as:

$$fee_{step} = \left(\sqrt{P_{start}} - \sqrt{P_{end}}\right) L_{fee}$$

2.5 User profit expectations

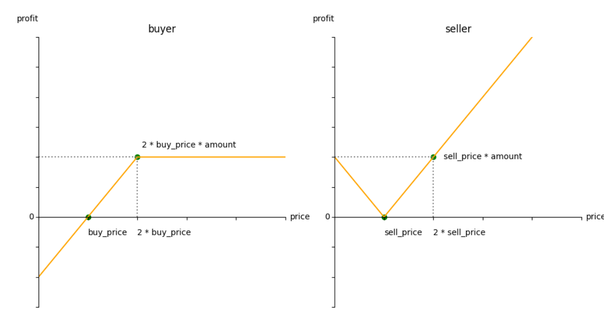

Figure 6: Profit curve

As shown in Figure6, user profit expectations can be discussed from two perspectives:

- **Buyers:** When the price is lower than the buyer's purchase price, the buyer incurs a loss equal to the difference between the purchase price and the settlement price. When the price is higher than the buyer's purchase price, the buyer gains a profit equal to the difference between the purchase price and the settlement price. The maximum profit the buyer can obtain is twice the purchase price. It is important to note that the profit curve illustrates the expected outcomes for buyers who maintain their positions until maturity. However, users have the option to close their positions at any time prior to maturity in order to realize their Profit and Loss (PnL).

- **Sellers:** If the seller refuses to fulfill the contract, they lose the margin corresponding to their position. If the seller fulfills the contract, they receive the normal profit from selling the point/pre-launch token. When the price is between 0 and twice the selling price, the seller will choose to settle. In this case, the seller's profit, compared to not selling initially, is the selling revenue minus the current token price. When the price is higher than twice the selling price, the seller will not settle but instead sell the tokens directly, which aligns with the profit curve of simply holding the asset.

3 CAPITAL EFFICIENCY

Bubbly Finance enhances the capital efficiency of liquidity providers in three ways:

- **Concentrated liquidity:** LPs can provide liquidity within a specified price range, significantly improving capital efficiency compared to providing liquidity across the entire range.
- **Recycling margin:** In spot AMMs, adding liquidity requires both assets. However, under the MLMM mechanism, only margin corresponding to the larger asset value is needed. Due to price movements, LPs only need to ensure that the margin amount meets the delivery of liquidity on one side, so they do not need to provide liquidity for the entire specified price range.
- **Reinvested underlying assets:** Due to the design of the vAMM, both traders and LPs can have their margin assets reinvested into trusted yield-bearing protocols. For instance, ETH can be invested in the Ethereum Restaking protocols, while WBTC or BTC.b can be invested in the Bitcoin Staking protocols. This allows users' liquidity to earn passive incentives from these protocols.

4 INSTANT MATURITY

In most standard futures markets, traders typically have to wait for their counterparties to complete delivery before they can claim the corresponding assets. This is essentially due to the inefficiencies of the peer-to-peer matching model. However, the liquidity pool based on MLMM allows buyers to claim assets according to the global settlement status, further reducing the capital lock-up time during the high-frequency fluctuation period of the Token Generation Event (TGE).

We record all the positions average price of initial opening, where $x_{settled}$ represents the amount of points/pre-launch tokens the sellers delivered and $y_{deposited}$ represents the amount of margins the seller deposit. The process of calculating the settlement threshold price is as follows:

$$price_{maturity} = \frac{\sum y_{deposited}}{\sum x_{settled}}$$

In principle, buyers who purchase at higher prices can complete settlement earlier. As sellers continuously complete their deliveries, the settlement threshold price of the entire liquidity pool decreases, allowing more buyers to claim their settlement assets.

5 SUMMARY

In summary, Bubbly Finance is a non-custodial, non-upgradeable, and permissionless AMM protocol, which focuses on the standard futures market. It builds upon the concentrated liquidity model introduced in Uniswap v3 and the concept of margin from traditional futures. Pre-market assets are essentially a form of standard futures with physical deliveries. With the design of Margin Liquidity Market Makers (MLMM), Bubbly Finance will bring the benefits of both worlds: a simple and timely trading experience, better liquidity depth and volume, and strong price discovery.

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