Explanation of some other custom features techniques

1. **Order Book Depth Ratio:** This feature calculates the ratio of the cumulative bid quantity to the cumulative ask quantity at various levels (e.g., level 2, level 5, level 10). It can provide insights into the pressure and liquidity on both sides of the order book.

   Order book depth ratio at level 5:

   ```python
   depth_data['depth_ratio_lvl5'] = (
       depth_data[[f'BidQtyL{i}' for i in
           ↪ range(1, 6)]].sum(axis=1) /
       depth_data[[f'AskQtyL{i}' for i in
           ↪ range(1, 6)]].sum(axis=1)
   )
   ```

2. **Price Acceleration:** This feature measures the change in price movement over time. A sudden increase in price acceleration can indicate a shift in market sentiment or the presence of large orders.

   ```python
   depth_data['price_acceleration'] =
       ↪ depth_data['mid_price'].diff(2)
   ```

3. **Trade Imbalance Ratio:** This feature is similar to volume imbalance but uses a rolling window to calculate the ratio of buy-initiated trades to sell-initiated trades over a specific period.

   ```python
   window = 10  # Define the rolling window
   trade_data['trade_imbalance_ratio'] = (
       trade_data['IsMarketMaker'].rolling(
           ↪ window).sum() /
       window
   )
   ```

Visualizations

Market Regimes Visualization (UMAP)

Regime Timeline

Regime Characteristics (Parallel Coordinates)

Regimes in 3D Feature Space

Regime Characteristics