

## product information.

### 1 Reconstructed Limit Order Book Data Derived from NASDAQ's Historical TotalView-ITCH

#### 1.1 Underlying Data:

1. Raw Message Data:

The limit order book data is reconstructed from NASDAQ's Historical TotalView-ITCH message data. For more information on NASDAQ's Historical TotalView-ITCH please visit <http://www.nasdaqtrader.com/Trader.aspx?id=ITCH>

2. Database Period:

LOBSTER's database of raw message data includes the following NASDAQ Historical TotalView-ITCH version(s):

- Version 4.1: April 27-th 2010 until the trading day before yesterday.

#### 1.2 Output Structure:

1. Description:

LOBSTER generates a 'message' and an 'orderbook' file for each active trading day of a selected ticker. The 'orderbook' file contains the evolution of the limit order book up to the requested number of levels. The 'message' file contains indicators for the type of event causing an update of the limit order book in the requested price range. All events are timestamped to seconds after midnight, with decimal precision of at least milliseconds and up to nanoseconds depending on the requested period.

2. Message File:

- Format: CSV
- Dimensions: Matrix of size (Nx6), with N the number of limit order events in the price range defined by the requested number of levels.
- Name: TICKER\_Year-Month-Day\_StartTime\_EndTime\_message\_LEVEL.csv  
StartTime and EndTime give the theoretical beginning and end time of the output file in milliseconds after midnight. LEVEL refers to the number of levels of the requested limit order book.
- Columns:
  1. Time: Seconds after midnight with decimal precision of at least milliseconds and up to nanoseconds depending on the requested period.
  2. Type:
    - '1' Submission of a new limit order.
    - '2' Cancellation (Partial deletion of a limit order).
    - '3' Deletion (Total deletion of a limit order).
    - '4' Execution of a visible limit order.
    - '5' Execution of a hidden limit order.
    - '7' Trading halt indicator (Detailed information below).
  3. Order ID: Unique order reference number (Assigned in order flow).
  4. Size: Number of shares.
  5. Price: Dollar price times 10000 (i.e., a stock price of \$91.14 is given by 911400).

6. Direction: -1: Sell limit order; 1: Buy limit order Note: Execution of a sell (buy) limit order corresponds to a buyer (seller) initiated trade, i.e. Buy (Sell) trade.

### 3. Orderbook File:

- Format: CSV
- Dimensions: Matrix of size (Nx(4xLEVEL)), with N and LEVEL as defined above.
- Name: TICKER\_Year-Month-Day\_StartTime\_EndTime\_orderbook\_LEVEL.csv  
Terms as defined above.
- Columns:
  1. Ask price 1: Level 1 ask price (Best ask price)
  2. Ask size 1: Level 1 ask volume (Best ask volume)
  3. Bid price 1: Level 1 bid price (Best bid price)
  4. Bid size 1: Level 1 bid volume (Best bid volume)
  5. Ask price 2: Level 2 ask price (2nd best ask)
  - ... ..

### 4. Remarks:

- Ticker:  
The term 'ticker' refers to a ticker symbol used in NASDAQ's TotalView-ITCH message data to uniquely identify publicly traded shares of a particular stock or asset.
- Levels:  
The term 'level' refers to occupied price levels. A level 1 order book contains the best ask and bid prices and their respective volumes. A level 2 order book contains the best and second best ask and bid prices and their respective volumes. Based on this definition the difference between two levels in LOBSTER's output is not necessarily the minimum tick size.
- Unoccupied Price Levels:  
When the selected number of levels exceeds the number of levels available the empty order book positions are filled with dummy information to guarantee a symmetric output. The extra bid and/or ask prices are set to -999999999 and 999999999, respectively. The corresponding volumes are set to 0.
- Trading Halts:  
When trading halts, a message of type '7' is written into the 'message' file. The corresponding price and trade direction are set to '-1' and all other properties are set to '0'. Should the resume of quoting be indicated by an additional message in NASDAQ's Historical TotalView-ITCH files, another message of type '7' with price '0' is added to the 'message' file. Again, the trade direction is set to '-1' and all other fields are set to '0'. When trading resumes a message of type '7' and price '1' (Trade direction '-1' and all other entries '0') is written to the 'message' file. For messages of type '7', the corresponding order book rows contain a duplication of the preceding order book state. The reason for the trading halt is not included in the output.
- Time Window:  
The limit order books provided by LOBSTER give the dynamics during regular trading hours, i.e. the time between 09:30:00 and 16:00:00 EST. Extensions to the pre-trading session will be available in the future.
- Hidden Order Executions:  
Hidden order executions are included in LOBSTER's message file with a duplication of the previous limit order book state recorded in order book file. The execution message includes the exact time stamp, the size, direction and price of the executed order. Further, the message includes an order ID field. According to NASDAQ's data specification, before December 6-th 2010 NASDAQ's Historical TotalView-ITCH contained hidden order execution messages which included a unique order ID. In all files supplied after December 6-th 2010 the field has been set to '0'.

Should NASDAQ's Historical TotalView-ITCH files contain a unique order ID in the hidden order execution message, the order ID is included in LOBSTER's output, otherwise the field is set to '0'.

- Other events:  
Beyond the usual limit order activities - submissions, cancellations, deletions and executions - NASDAQ's Historical TotalView-ITCH files contain other messages such as net order imbalances indicators. These messages are ignored and skipped by the limit order book reconstruction algorithm, since they do not affect the evolution of the limit order book.

### **1.3 General Remarks:**

- Ticker and Company Names:  
The request interface for reconstructed limit order book data is based on the tickers used in NASDAQ's Historical TotalView-ITCH files. LOBSTER does not provide an interface that allows searching the company ticker based on the company's name or vice versa. Users are asked to identify the ticker of a company of interest relying on third party services.
- Compressed Files:  
The limit order book files provided for download are compressed using the open source tool 7-zip to reduce download times. Accessing the data in the .CSV format requires the user to extract the downloaded archives via 7-zip, which must be installed user's computer.