Flexion Trading Theory: A Structural Framework for Geometric Market Dynamics

Marian Bohdanov

December 3, 2025

Abstract

Flexion Trading Theory (FTT) introduces a purely structural and deterministic framework for understanding market dynamics by interpreting the price series $P(t)$ as a geometric object with measurable curvature and torsion. Instead of modelling volatility, patterns, or statistical distributions, FTT derives all trading decisions from discrete flexion derivatives—the first-order price change $\Delta P(t)$, the curvature $C(t)$, and the torsion $\Delta S(t)$—computed on an adaptive structural window.

The theory defines two fundamental geometric events: the *Flexion Entry Window* (FEW), marking the initiation of a coherent bending regime, and the *Flexion Break* (FXB), marking torsional collapse and mandatory exit. Both events arise solely from the intrinsic structure of $P(t)$ and require no external indicators, thresholds, probabilistic filters, or empirical tuning.

By combining flexion derivatives, structural orientation, and adaptive stability filters, FTT provides a complete decision function (FTT_API) that maps observable ticker data to deterministic trading actions. This theoretical foundation enables the Flexion Trading Runtime Engine (FTRE), a platform-independent executable specification that implements FTT without modification.

FTT establishes a universal geometric description of market impulses, offering a reproducible, deterministic, and structurally grounded alternative to classical technical analysis.

1 Introduction

Financial markets are commonly modelled through statistical, stochastic, or indicator-based frameworks that rely on assumptions about volatility, distributional properties, or price patterns. Flexion Trading Theory (FTT) departs fundamentally from these approaches by treating the market not as a stochastic generator of prices but as a *geometric structure* evolving through time.

In FTT, the only observable quantity is the discrete price sequence $P(t)$. From this sequence, the theory derives a hierarchy of *flexion derivatives*—the first derivative $\Delta P(t)$ (directional motion), the second derivative $C(t)$ (curvature), and the third derivative $\Delta S(t)$

(torsion). These derivatives enable a precise structural interpretation of price evolution that is independent of volatility modeling, pattern recognition, machine learning, or traditional technical indicators.

The core insight of FTT is that market impulses can be described entirely by geometric transitions in curvature and torsion. Two events define the complete structural lifecycle of an impulse: (1) the *Flexion Entry Window* (FEW), marking the birth of a coherent bending regime aligned with structural orientation, and (2) the *Flexion Break* (FXB), marking the torsional collapse of that regime.

This perspective yields a deterministic trading framework in which signals arise solely from the intrinsic geometry of $P(t)$, without recourse to external parameters, empirical adjustment, or probabilistic filtering. FTT thus stands as a fully reproducible, purely structural model of trading decision-making.

Finally, the theory provides a formal mapping to the Flexion Trading Runtime Engine (FTRE), which implements FTT as a platform-independent computational engine. This ensures that the structural logic of the theory remains faithful and consistent across trading environments, making FTT both a scientific framework and a practical foundation for automated trading systems.

2 Observable Domain

Flexion Trading Theory (FTT) operates exclusively on observable market data. No latent variables, statistical estimates, or external indicators enter the theory. At every discrete event index t, the sole observable is the last traded price $P(t)$, from which all structural quantities are derived.

2.1 Price Series

The price series is defined as a discrete sequence

$$P(t), \qquad t \in \mathbb{Z}^+,$$

where each index corresponds to a market tick. FTT does not assume continuity, differentiability, or stochastic properties of the price series. Only the ordering and numerical values of $P(t)$ are relevant for the theory.

2.2 Event Time Basis

The temporal structure of FTT is based on event order rather than physical time. The sequence $t = 0, 1, 2, \ldots$ denotes successive observed price updates, regardless of their wall-clock spacing. Thus, FTT remains invariant under irregular tick arrival, latency variations, and session-specific timing effects.

2.3 Internal Structural Window

FTT uses a finite rolling window of past observations,

$$W(t) = \{P(t-k) \mid k = 0, 1, \ldots, W(t)\},$$

to compute flexion derivatives and structural quantities. Unlike fixed-size windows common in technical analysis, $W(t)$ is *adaptive* and determined by structural stability conditions (Section 6).

This windowing mechanism ensures that structural calculations remain meaningful even under noise or fluctuating market regimes.

2.4 Exclusion of External Inputs

FTT explicitly forbids the use of:

- volume data,
- OHLC aggregations,
- volatility estimates,
- statistical indicators,
- moving averages,
- configurable thresholds or empirical parameters.

All structural features arise exclusively from observable price data and its discrete variations. This restriction ensures full theoretical purity and reproducibility.

2.5 Closed Observable System

The observable domain of FTT is a closed system:

$$P(t) \longrightarrow \Delta P(t),\, C(t),\, \Delta S(t) \longrightarrow K(t) \longrightarrow \text{Events} \longrightarrow \text{FTT\_API}.$$

Every quantity used by the theory is either directly observable or derived from $P(t)$. No external assumptions or market-specific features influence the structural logic of the model.

3 Flexion Derivatives

Flexion Trading Theory interprets market structure through discrete geometric derivatives of the observable price series. These derivatives capture directional motion, curvature, and torsional instability, forming the minimal and complete structural basis of FTT.

All derivatives are defined on the adaptive structural window $W(t)$ described in Section 6. No smoothing, averaging, interpolation, or external filtering is permitted.

3.1 First Flexion Derivative: $\Delta P(t)$

The first derivative measures instantaneous directional change:

$$\Delta P(t) = P(t) - P(t-1).$$

Properties:

- $\operatorname{sign}(\Delta P(t))$ indicates local upward or downward motion,
- $|\Delta P(t)|$ reflects impulse intensity,
- provides the foundation for higher-order derivatives.

$\Delta P(t)$ is the elemental geometric primitive from which curvature and torsion emerge.

3.2 Second Flexion Derivative: $C(t)$

The second derivative,

$$C(t) = \Delta P(t) - \Delta P(t-1),$$

represents geometric curvature of the price trajectory.

Interpretation:

- $C(t) > 0$ — upward (convex) bending,
- $C(t) < 0$ — downward (concave) bending,
- $C(t) = 0$ — locally linear structural motion.

Curvature is the primary driver of structural orientation $K(t)$.

3.3 Third Flexion Derivative: $\Delta S(t)$

The third derivative,

$$\Delta S(t) = C(t) - C(t-1),$$

measures torsion: the rate at which curvature changes direction.

Interpretation:

- peaks of $\Delta S(t)$ signify structural instability,
- extremal values correspond to torsion collapse (FXB),
- zero-crossings mark transitions between bending regimes.

$\Delta S(t)$ is the core geometric quantity governing exit logic.

3.4 Discrete Derivative Properties

All flexion derivatives satisfy strict locality:

$$\Delta P(t),\ C(t),\ \Delta S(t) \quad \text{depend only on} \quad P(t), P(t-1), P(t-2), P(t-3).$$

No additional memory or long-range dependencies are allowed. This guarantees:

- determinism,
- reproducibility across platforms,
- independence from tick-rate variation.

3.5 Minimal Structural Basis

The triplet

$$(\Delta P(t),\, C(t),\, \Delta S(t))$$

forms the minimal complete set of structural descriptors of price evolution.

No additional derivatives or transformations are required to define:

- structural orientation,
- initiation events (FEW),
- collapse events (FXB),
- the full decision function (FTT_API).

Thus the flexion derivatives constitute the canonical geometric representation of market structure in FTT.

4 Structural Orientation

Structural orientation $K(t)$ defines the dominant geometric direction of market motion. It is derived exclusively from curvature $C(t)$ and reflects the persistent bias of bending within the adaptive structural window $W(t)$.

Orientation acts as a directional stability mechanism: it ensures that only structurally meaningful bending regimes produce valid entry events. Noise-driven curvature fluctuations, lacking geometric persistence, are suppressed by $K(t)$.

4.1 Definition of Structural Orientation

FTT defines orientation as the sign of cumulative curvature across the adaptive window:

$$K(t) = \operatorname{sign}\left(\sum_{i=0}^{W(t)} C(t-i) \right).$$

Thus:

$$K(t) = \begin{cases} +1, & \text{if upward curvature dominates,} \\ -1, & \text{if downward curvature dominates,} \\ 0, & \text{if curvature lacks a stable direction.} \end{cases}$$

This definition ensures that $K(t)$ emerges directly from the underlying geometry of $P(t)$.

4.2 Geometric Interpretation

Upward Orientation ($K = +1$). Curvature values tend to be positive, indicating a convex structural regime. Upward flexion signals (FEW_UP) are permitted.

Downward Orientation ($K = -1$). Curvature values tend to be negative, indicating a concave structural regime. Downward flexion signals (FEW_DN) are permitted.

Neutral Orientation ($K = 0$). Curvature lacks a stable sign; the structure is transitional or dominated by micro-noise. All FEW events are suppressed in this regime.

4.3 Role of Orientation in Event Logic

Orientation imposes necessary constraints on entry logic:

- FEW may occur only when $K(t) \neq 0$,
- FEW direction must match $K(t)$,
- opposite-direction curvature changes are ignored as noise.

This geometric filter prevents premature or invalid entries triggered by microscopic curvature fluctuations.

4.4 Relation to Torsion and Collapse

While orientation governs *entry* (FEW) conditions, it has no influence on *exit* (FXB) conditions. Torsion collapse is a symmetric geometric event detected solely by $\Delta S(t)$.

The division of roles:

- $K(t)$ — determines directional structural validity,
- $\Delta S(t)$ — determines collapse of bending,

ensures that FTT maintains both geometric purity and practical structural stability.

4.5 Deterministic and Parameter-Free

Orientation is computed without:

- smoothing averages,
- thresholds,
- tunable parameters,
- probabilistic estimates.

It depends only on the discrete curvature values within $W(t)$ and is therefore deterministic, reproducible, and invariant across platforms.

5 Structural Events

Flexion Trading Theory defines market transitions through two fundamental structural events derived exclusively from the geometric behavior of the flexion derivatives. These events describe the birth and collapse of coherent bending regimes in the price trajectory:

- **FEW** — Flexion Entry Window (structural initiation),
- **FXB** — Flexion Break (structural collapse).

No additional event types exist in the theory. FEW marks the beginning of a structurally coherent impulse, whereas FXB marks its termination at torsion extremum. Together they form the complete structural lifecycle of a trade.

5.1 FEW: Flexion Entry Window

A FEW event represents the moment when the market enters a new bending regime aligned with the dominant structural orientation $K(t)$.

Formal Definition

A FEW event occurs at time t if and only if all the following conditions hold:

(1) **Orientation Alignment:**

$$\text{sign}(C(t)) = K(t), \qquad K(t) \neq 0.$$

(2) **Curvature Emergence:**

$$C(t-1) = 0, \qquad C(t) \neq 0.$$

This ensures FEW corresponds to the *first* moment of bending.

(3) **Curvature Strengthening:**

$$C(t) > C(t-1) \quad \text{if } K(t) = +1,$$

$$C(t) < C(t-1) \quad \text{if } K(t) = -1.$$

Thus:

$$\text{FEW\_UP} \longleftrightarrow K(t) = +1, \qquad \text{FEW\_DN} \longleftrightarrow K(t) = -1.$$

Interpretation

FEW corresponds to:

- the birth of curvature,
- the initiation of geometric bending,
- the structurally valid entry into a market impulse.

FEW is never triggered by:

- price patterns,
- volatility changes,
- statistical indicators,
- oscillatory micro-noise.

It arises purely from the intrinsic geometry of $P(t)$.

5.2 FXB: Flexion Break

FXB marks the moment when the bending regime becomes unstable and collapses. It is defined by the behavior of torsion $\Delta S(t)$.

Formal Definition

A FXB event occurs at time t if and only if:

(1) **Torsion Extremum:** $\Delta S(t)$ is a strict local extremum:

$$\Delta S(t-1) < \Delta S(t) > \Delta S(t+1) \quad \text{(peak)},$$
$$\Delta S(t-1) > \Delta S(t) < \Delta S(t+1) \quad \text{(trough)}.$$

(2) **Non-Degeneracy:**

$$\Delta S(t) \neq \Delta S(t-1), \qquad \Delta S(t) \neq \Delta S(t+1).$$

FXB is *independent* of orientation:

$$K(t) \text{ plays no role in FXB detection.}$$

Interpretation

FXB corresponds to:

- the point of maximum torsional instability,
- the geometric collapse of bending,
- the mandatory structural exit of a trade.

FXB always terminates the current structural cycle.

5.3 Structural Cycle Consistency

The two events form a strict geometric sequence:

$$\text{FEW}(t_0) \longrightarrow \text{FXB}(t_1), \qquad t_1 > t_0.$$

The following invariants must hold:

- no FEW may occur after FEW and before FXB,
- no FXB may occur without a preceding FEW,
- each FEW must eventually be followed by an FXB,
- exactly one FEW and one FXB per structural cycle.

These invariants guarantee a well-defined geometric lifecycle of market impulses.

6 Flexion Windows and Stability Filters

Flexion Trading Theory employs an adaptive structural window and a set of deterministic stability filters to ensure that structural events (FEW, FXB) are computed on a geometrically meaningful basis rather than on raw tick-level noise. These mechanisms do not introduce smoothing, heuristics, or empirical tuning; instead, they preserve the structural purity of the theory while enforcing numerical stability.

The adaptive window $W(t)$ governs the locality of structural calculations, while the filters $\mu(t)$, $M(t)$, and $\Theta(t)$ ensure that FEW events are triggered only when market geometry exhibits coherent bending.

6.1 Adaptive Structural Window $W(t)$

The structural window $W(t)$ defines how many past observations are used to evaluate curvature, orientation, and stability. Unlike fixed lookback windows typical of technical indicators, $W(t)$ expands or contracts based on structural consistency.

Definition

$W(t)$ is defined as the minimum window length for which curvature sign stabilizes:

$$W(t) = \min \left\{ k \ : \ \operatorname{sign}\left(\sum_{i=0}^{k} C(t-i) \right) = \operatorname{sign}\left(\sum_{i=0}^{k+1} C(t-i) \right) \right\}.$$

Interpretation:

- small $W(t)$ (3–7 ticks) indicates stable bending,
- large $W(t)$ indicates geometric inconsistency or noise.

The window adapts purely from geometric structure and introduces no external parameters.

6.2 Magnitude Filter $\mu(t)$

The magnitude filter ensures that only structurally meaningful impulses trigger FEW events. It is defined as:

$$\mu(t) = |\Delta P(t)|.$$

The FEW event is allowed only when:

$$\mu(t) > \mu_{\min}(W(t)),$$

where $\mu_{\min}(W)$ grows with window size. This requirement suppresses micro-fluctuations that occur during high-noise conditions.

6.3 Curvature Stability Filter $M(t)$

The curvature stability filter measures the average magnitude of curvature over the structural window:

$$M(t) = \frac{1}{W(t)+1} \sum_{i=0}^{W(t)} |C(t-i)|.$$

FEW is permitted only when instantaneous curvature exceeds a scaled stability threshold:

$$|C(t)| > \alpha\, M(t),$$

with α representing the minimal structural dominance required for coherent bending. This filter prevents FEW from triggering during geometric inconsistencies.

6.4 Temporal Coherence Filter $\Theta(t)$

The temporal coherence filter ensures that torsion dynamics remain meaningful within the structural window. It is defined as:

$$\Theta(t) = \frac{W(t)}{|\Delta S(t)| + \varepsilon},$$

where ε is the smallest nonzero torsion increment imposed by the discrete price grid.

Interpretation:

- small $\Theta(t)$ indicates strong and coherent torsion,
- large $\Theta(t)$ indicates degeneracy or noise.

FEW is suppressed when $\Theta(t)$ exceeds an upper coherence bound $\Theta_{\max}$.

6.5 Summary of Stability Filters

A FEW event is valid only when:

- orientation alignment is satisfied ($K(t) \neq 0$),
- curvature direction agrees with orientation,
- curvature is strengthening,
- impulse magnitude is sufficient: $\mu(t) > \mu_{\min}(W)$,
- curvature is coherent: $|C(t)| > \alpha M(t)$,
- torsion is temporally consistent: $\Theta(t) < \Theta_{\max}$.

These filters do not alter the structural meaning of the derivatives; rather, they guarantee that flexion events reflect real geometric transitions rather than microstructural noise.

7 Flexion Trading Structural Cycle

The Flexion Trading Structural Cycle (FTSC) is the complete geometric lifecycle of a market impulse as defined by Flexion Trading Theory. It encapsulates the transition from structural initiation to structural collapse through the interaction of curvature, torsion, and orientation.

The cycle consists of three deterministic stages:

1. **Structural Initiation (FEW)**,
2. **Structural Propagation**,
3. **Structural Collapse (FXB)**.

This cycle governs the lifecycle of every valid trade in FTT.

7.1 Stage 1: Structural Initiation (FEW)

Structural initiation begins when the market enters a coherent bending regime aligned with the dominant orientation $K(t)$.

A FEW event requires:

- curvature emerging from linearity ($C(t-1) = 0$, $C(t) \neq 0$),
- curvature strengthening in the direction of $K(t)$,
- all stability filters satisfied,
- nonzero orientation ($K(t) \neq 0$).

At FEW:

- the bending regime begins,
- the structural impulse becomes coherent,
- a trade is *opened* in the direction of $K(t)$.

Thus:

$$\text{FEW\_UP} \rightarrow \text{long position}, \qquad \text{FEW\_DN} \rightarrow \text{short position}.$$

7.2 Stage 2: Structural Propagation

During propagation, the market structure evolves in the direction established at FEW. The structure remains coherent under the following invariants:

(1) orientation must retain sign: $\text{sign}(K(t)) = \text{sign}(K(t_0))$,
(2) curvature must preserve direction relative to $K(t)$,
(3) no torsion extremum may occur ($\Delta S(t)$ not at local peak/trough),
(4) stability filters must remain satisfied.

Propagation represents the geometric "life" of the structural impulse. No additional entries may occur during this phase.

7.3 Stage 3: Structural Collapse (FXB)

Structural collapse occurs when torsion reaches a strict local extremum, indicating instability in the curvature regime.

A FXB event is detected when:

$$\Delta S(t-1) < \Delta S(t) > \Delta S(t+1) \quad \text{or} \quad \Delta S(t-1) > \Delta S(t) < \Delta S(t+1),$$

with non-degeneracy constraints

$$\Delta S(t) \neq \Delta S(t-1), \qquad \Delta S(t) \neq \Delta S(t+1).$$

At FXB:

- curvature coherence collapses,
- the structural impulse terminates,
- the open position must be closed.

FXB is direction-agnostic and independent of $K(t)$.

7.4 Cycle Invariants

Each structural cycle satisfies:

- exactly one FEW per cycle,
- exactly one FXB per cycle,
- FEW must precede FXB,
- no FEW may occur between FEW and FXB,
- no FXB may occur before an active FEW.

These invariants ensure that the FTSC forms a closed and deterministic geometric system:

$$\text{FEW} \longrightarrow \text{Propagation} \longrightarrow \text{FXB}.$$

8 Formal Decision Function (FTT_API)

The Formal Decision Function, denoted FTT_API, is the canonical mapping from observable market data to discrete structural trading signals. It provides a complete, deterministic rule set for interpreting geometric transitions in the price series using only flexion derivatives and the adaptive structural filters.

FTT_API outputs exactly one action at each event index t:

$$\text{FTT\_API}(t) \in \{0, 1, 2, 3\},$$

representing:

$$0 = \text{NONE}, \qquad 1 = \text{FEW\_UP}, \qquad 2 = \text{FEW\_DN}, \qquad 3 = \text{FXB}.$$

8.1 Input Domain

The only external input to FTT_API is the observable price sequence

$$P(t),\ P(t-1), \ldots, P(t - W(t)).$$

All internal structural quantities used by the API are computed from $P(t)$:

$$\Delta P(t),\ C(t),\ \Delta S(t),\ K(t),\ W(t),\ \mu(t),\ M(t),\ \Theta(t).$$

These quantities are never externally supplied or tuned.

8.2 Event Evaluation Order

FTT imposes a strict priority hierarchy when evaluating structural events:

(1) **FXB** — collapse event (highest priority),
(2) **FEW** — initiation event,
(3) **NONE** — fallback when no structural transition occurs.

The priority ordering ensures that torsion collapse (FXB) always overrides initiation (FEW), reflecting its structural significance.

8.3 FXB Logic

A FXB event is triggered when torsion reaches a strict extremum:

$$\Delta S(t-1) < \Delta S(t) > \Delta S(t+1)$$

or

$$\Delta S(t-1) > \Delta S(t) < \Delta S(t+1),$$

with non-degeneracy constraints:

$$\Delta S(t) \neq \Delta S(t-1), \qquad \Delta S(t) \neq \Delta S(t+1).$$

If FXB is detected:

$$\text{FTT\_API}(t) = 3.$$

8.4 FEW Logic

A FEW event is triggered when curvature begins a coherent bending regime in the direction of $K(t)$ and all stability filters are satisfied.

Formally:

(1) $\text{sign}(C(t)) = K(t)$ and $K(t) \neq 0$,
(2) $C(t-1) = 0$, $C(t) \neq 0$,
(3) strengthening condition:

$$C(t) > C(t-1) \quad \text{if } K(t) = +1,$$

$$C(t) < C(t-1) \quad \text{if } K(t) = -1,$$

(4) stability filters satisfied:

$$\mu(t) > \mu_{\min}(W(t)), \qquad |C(t)| > \alpha M(t), \qquad \Theta(t) < \Theta_{\max}.$$

If FEW conditions hold:

$$\text{FTT\_API}(t) = \begin{cases} 1, & K(t) = +1, \\ 2, & K(t) = -1. \end{cases}$$

8.5 NONE Logic

If neither FEW nor FXB conditions are satisfied:

$$\text{FTT\_API}(t) = 0.$$

NONE indicates that the structure remains either linear, transitional, or propagating without collapse.

8.6 Determinism and Purity

FTT_API satisfies the following formal guarantees:

- **Determinism:** identical price sequences produce identical outputs.
- **Locality:** decisions depend only on recent values within $W(t)$.
- **Purity:** no stochastic behavior, smoothing, or empirical tuning.
- **Completeness:** every structural state maps to exactly one output.

Thus, FTT_API defines a closed, fully deterministic geometric decision system.

9 Mapping to Runtime Engine (FTRE)

The Flexion Trading Runtime Engine (FTRE) is the canonical executable implementation of Flexion Trading Theory. Its purpose is to translate the mathematical constructs of FTT into a deterministic, platform-independent computational process. FTRE introduces no new logic and uses no additional parameters; every step is a direct operationalization of the theoretical rules defined in Sections 3–8.

FTRE ensures that FTT remains:

- reproducible across environments,
- invariant under platform-specific differences,
- free from heuristics, smoothing, or stochastic behavior,
- strictly deterministic given identical price sequences.

9.1 Architectural Principles

The runtime engine adheres to three non-negotiable invariants:

Purity. All structural quantities computed inside FTRE

$$\Delta P(t),\ C(t),\ \Delta S(t),\ K(t),\ W(t),\ \mu(t),\ M(t),\ \Theta(t)$$

must be derived exclusively from $P(t)$ and its discrete differences.

Determinism. For any two identical price sequences, FTRE must produce identical sequences of structural events and API outputs. No randomness, smoothing, or adaptive heuristics may influence decision generation.

Canonical Mapping. FTRE must implement FTT_API exactly as defined in Section 8, without alteration or extension of event logic.

9.2 Internal Processing Pipeline

For each new observed price $P(t)$, FTRE executes the following deterministic pipeline:

Step 1: Window Update Append $P(t)$ to local memory; adapt $W(t)$ via curvature stability; discard values outside the structural window.

Step 2: Compute Flexion Derivatives

$$\Delta P(t) = P(t) - P(t-1),$$

$$C(t) = \Delta P(t) - \Delta P(t-1),$$

$$\Delta S(t) = C(t) - C(t-1).$$

Step 3: Compute Structural Orientation

$$K(t) = \operatorname{sign}\left(\sum_{i=0}^{W(t)} C(t-i)\right).$$

Step 4: Compute Stability Filters

$$\mu(t) = |\Delta P(t)|,$$

$$M(t) = \frac{1}{W(t)+1} \sum_{i=0}^{W(t)} |C(t-i)|,$$

$$\Theta(t) = \frac{W(t)}{|\Delta S(t)| + \varepsilon}.$$

Step 5: Event Evaluation Evaluate FXB and FEW using the strict priority order defined in Section 8.

Step 6: State Transition Update the structural trading state (FLAT, LONG, SHORT) using deterministic transition rules.

Step 7: Output Structural Code Return the integer action code:

$$0 = \text{NONE}, \quad 1 = \text{FEW\_UP}, \quad 2 = \text{FEW\_DN}, \quad 3 = \text{FXB}.$$

This pipeline contains no conditional branches beyond those defined by the theory. All computations involve only primitive arithmetic operations and minimal memory, ensuring high performance and platform independence.

9.3 Canonical Public API

FTRE exposes exactly one public method:

```
int FTRE_Evaluate(double price, int timestamp);
```

which returns:

$$0,\ 1,\ 2,\ 3$$

according to the structural state at time t. No additional outputs, diagnostic flags, or auxiliary data streams are allowed at the API level. Any debugging or logging functionality must remain strictly optional and external.

9.4 Implementation Independence

FTRE must produce identical results across:

- programming languages (C++, Python, MQL4/5),
- operating systems (Linux, Windows, macOS),
- brokers and trading platforms,
- live and historical price feeds,
- varying tick arrival rates or latencies.

Platform differences must not influence structural outcomes because FTT depends only on the ordering and values of $P(t)$.

9.5 Completeness of Mapping

Every component of FTRE corresponds directly to a theoretical construct:

$$\begin{aligned}
\text{Derivative Engine} &\longleftrightarrow \text{Section 3},\\
\text{Orientation Engine} &\longleftrightarrow \text{Section 4},\\
\text{Event Engine} &\longleftrightarrow \text{Section 5},\\
\text{Filter Engine} &\longleftrightarrow \text{Section 6},\\
\text{Cycle Logic} &\longleftrightarrow \text{Section 7},\\
\text{Decision Function} &\longleftrightarrow \text{Section 8}.
\end{aligned}$$

No additional logic exists beyond the theory. FTRE is therefore the authoritative executable reference of Flexion Trading Theory.

10 Discussion

Flexion Trading Theory introduces a novel geometric framework for analyzing market dynamics, diverging from both traditional technical analysis and statistical modelling paradigms. Rather than relying on volatility estimates, oscillators, or probabilistic assumptions, FTT extracts structure directly from the discrete evolution of price through flexion derivatives. This perspective yields several important theoretical and practical implications.

10.1 A Deterministic Alternative to Classical Approaches

Classical trading methodologies often incorporate:

- smoothed indicators,
- stochastic models,
- probabilistic forecasts,
- heuristic rules or empirical tuning.

These approaches introduce inherent uncertainty and platform dependence. In contrast, FTT is entirely deterministic: given identical price sequences, it produces identical decisions across all environments. This determinism eliminates ambiguity and enables reproducibility across implementations, making FTT suitable for rigorous scientific and engineering contexts.

10.2 Structural Interpretation of Market Impulses

By interpreting price evolution as a geometric object, FTT reframes market impulses as structural transitions:

- FEW corresponds to the birth of curvature (structural initiation),
- FXB corresponds to torsional extremum (structural collapse).

This geometric viewpoint provides a coherent explanation for market movements without appealing to:

- behavioral assumptions,
- statistical noise models,
- pattern recognition templates.

Flexion structure becomes the lens through which market motion is organized and understood.

10.3 Role of Adaptive Windows and Filters

The adaptive structural window $W(t)$ and the stability filters $\mu(t)$, $M(t)$, and $\Theta(t)$ serve an essential purpose: they preserve the geometric purity of flexion derivatives while ensuring that structural events reflect meaningful market behavior rather than microstructural noise.

FTT avoids the pitfalls of both extremes:

- it does not smooth or distort the underlying data,
- yet it prevents overreaction to insignificant fluctuations.

This balance enables FTT to operate effectively on high-frequency tick data while maintaining a principled theoretical foundation.

10.4 Universality and Platform Independence

Because FTT depends solely on the ordering and values of $P(t)$, and not on wall-clock time or platform-specific features, it remains invariant across:

- brokers,
- executions speeds,
- feed irregularities,
- historical and live data environments.

This universality is especially important for reproducible research and for deploying FTRE across heterogeneous computational infrastructures.

10.5 Limitations and Scope

FTT does not attempt to model:

- long-term price trends,
- macroeconomic factors,
- liquidity conditions,
- spread, slippage, or execution constraints.

Its scope is purely structural: FTT describes *when* bending begins and *when* it collapses.

Execution-layer considerations, portfolio interactions, risk management, and market frictions lie outside the theory itself but can be integrated in systems that consume FTT_API outputs.

10.6 Implications for Algorithmic Trading

The strict determinism, minimalism, and universality of FTT make it well suited for:

- automated strategy design,
- real-time execution engines,
- scientific backtesting,
- reproducible performance comparisons.

Because FTRE can be implemented as a platform-independent library, FTT can serve as a stable mathematical core in high-frequency environments, research platforms, and production trading systems.

11 Conclusion

Flexion Trading Theory provides a deterministic and structurally grounded framework for interpreting market dynamics through the geometry of price evolution. By deriving curvature, torsion, and orientation directly from the discrete sequence of observable prices, FTT avoids reliance on stochastic assumptions, parameter tuning, or traditional technical indicators. Instead, market behavior is described in terms of coherent bending regimes and their eventual collapse.

The theory defines a complete structural lifecycle through two fundamental events:

- **FEW** — initiation of a bending regime,
- **FXB** — torsional collapse and termination.

These events, combined with adaptive windows and purely geometric stability filters, yield a formal decision function that maps raw price data to trading signals with full determinism and platform independence.

Furthermore, the theory maps directly and unambiguously to the Flexion Trading Runtime Engine (FTRE), ensuring consistent and faithful implementation across all environments. This separation between theory and execution preserves scientific rigor while enabling robust engineering applications.

FTT thus establishes a unified geometric viewpoint on short-term market structure, offering a reproducible alternative to probabilistic or heuristic approaches. Its minimal assumptions, strict locality, and computational clarity provide a solid theoretical foundation for future developments in algorithmic trading, structural market research, and automated decision systems.