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Stable Sketching and Helper Data for Biological Features

by [Nick Clark](#) | Published March 27, 2026 | [PDF](#)

The gap between continuous biological signals and discrete computational representations is bridged by stable sketching. This mechanism transforms noisy feature vectors into stable binary sketches using publicly storable helper data that assists reproduction of the same sketch from slightly different inputs. The helper data reveals nothing about the underlying biological signal, maintaining privacy while enabling consistency.

What It Is

Stable sketching converts continuous feature vectors into fixed-length binary representations through a two-part process. First, the feature vector is quantized using a banding scheme that assigns nearby feature values to the same binary output. Second, helper data is generated that captures the relationship between the feature vector and the band boundaries without revealing the feature values themselves.

The helper data enables future observations of the same biological source to reproduce the same binary sketch even when the raw feature values differ due to noise. This is the cryptographic mechanism that makes noise-tolerant hashing possible.

Why It Matters

Direct hashing of biological features fails because hash functions are designed to produce completely different outputs for slightly different inputs. A fingerprint scanned twice will never produce exactly the same feature vector, so direct hashing produces unrelated hashes. Stable sketching solves this by ensuring that feature vectors within the same noise tolerance band produce the same binary sketch.

The privacy guarantee is critical: the helper data can be stored publicly or alongside the identity record without compromising the biological signal. An attacker with access to the helper data cannot reconstruct the feature vector or determine which biological features it corresponds to.

How It Works

The sketching algorithm divides the feature space into bands and assigns each band a binary code. The helper data encodes the offset from the measured feature value to the nearest band center, enabling future measurements to snap to the correct band despite noise. Error-correcting codes provide additional robustness for features near band boundaries.

The band width is calibrated to the expected noise characteristics of the feature, which vary by acquisition tier. Wider bands tolerate more noise but provide less discriminative power. Narrower bands discriminate better but are more sensitive to noise.

What It Enables

Stable sketching enables deterministic binary representations from inherently noisy biological signals. This is the mechanism that makes biological hashing, domain separation, and cross-modal fusion computationally tractable. Without it, biological identity would require either storing raw biometric templates (a privacy violation) or accepting unreliable matching (a security failure).

[Biological Identity All 21 steps →](#)

Identity from behavioral continuity. No stored templates. No keys.

Primary Technical Disclosure

[◦ Continuity-Based Biological Identity Using Trust-Slope Validation](#)

Secondary Technical

[◦ Biological Trust Slope Construction: Identity Through Behavioral Continuity](#)[◦ Contact, Non-Contact, and Passive Resolution Modes for Biological Identity](#)[◦ Biological Hash Generation With Domain Separation](#)[◦ Biological State Inference From Continuity Baseline](#)[◦ Cross-Modal Biological Hash Fusion](#)[◦ Biological Continuity as Handoff Verification](#)[◦ Relational Trust Trajectories: Trust as Temporal Relationship](#)[◦ Identity as Behavioral Continuity: Beyond Single-Point Capture](#)[◦ Biological-Device-Agent Identity Layering](#)[◦ Biological Signal Acquisition Tiers](#)[◦ Noise-Tolerant Feature Normalization for Biological Signals](#)[◦ Stable Sketching and Helper Data for Biological Features](#)[◦ Predictive Identity Trajectory: Forecasting Biological Identity Evolution](#)[◦ Population-Scale Collision Resistance for Biological Hashes](#)[◦ Adaptive Indexing of Biological Trust Slopes](#)[◦ Delayed and Sparse Validation for Disconnected Environments](#)[◦ Policy-Governed Capability Binding for Biological Identity](#)[◦ Multi-Identity Delegation Without Biological Data Disclosure](#)[◦ External Credential Integration With Trust-Slope Integrity](#)[◦ Anti-Spoofing Through Continuity Validation](#)[◦ Identity Lifecycle Management and Phase-Based Reseeding](#)[◦ Quorum-Based Biological Identity Recovery](#)[◦ Privacy Governance and Revocation for Biological Identity](#)[◦ Human-Agent Primitive Integration for Biological Identity](#)

Applications (General)

[◦ Airport Security Without Biometric Databases](#)[◦ Estate Verification Through Behavioral Continuity](#)[◦ Biological Identity for Elder Care Continuity](#)[◦ Biological Identity for Child Development Tracking](#)[◦ Biological Identity for Addiction Recovery Monitoring](#)[◦ Biological Identity for Workplace Safety Monitoring](#)[◦ Biological Identity for Athletic Performance](#)[◦ Biological Identity for Immigration Processing](#)

Applications (Specific)

[◦ TSA PreCheck Matches Templates, Not Continuity](#)[◦ Global Entry Verifies Documents, Not Biological Continuity](#)[◦ Face ID Matches a Stored Model, Not a Living Trajectory](#)[◦ Samsung Knox Guards the Container, Not the Identity](#)[◦ ID.me Verifies Documents, Not Biological Continuity](#)[◦ Secure Scores Risk at a Single Point in Time](#)[◦ Plaid Identity Verifies Financial Accounts, Not Biological Persons](#)[◦ Onfido Detects Document Fraud, Not Identity Drift](#)[◦ Veriff Captures Sessions, Not Trajectories](#)[◦ Trulioo Queries Databases, Not Biological Trajectories](#)

[Biological Identity overview →](#)

AQ

deterministic

autonomy

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