| **Step** | **Name** | **What It Does** | **Output** |
| --- | --- | --- | --- |
| 1 | Data Setup | Loads motion capture file, calculates sampling rate | Raw marker positions + timestamps |
| 2 | Signal Cleaning | Applies 7Hz Butterworth filter to remove noise | Clean, smooth marker trajectories |
| 3 | Body Compass | Creates pelvis-based coordinate system (4 hip markers) | Moving reference frame (AP, ML, V axes) |
| 4 | Position Transform | Converts foot positions to body-relative coordinates | Heel/toe positions relative to pelvis |
| 5 | Speed Calculator | Calculates 3D velocity magnitude for all markers | How fast heel/toe/pelvis move through space |
| 6 | Position Detective | Zeni method - finds events using marker positions | Panel 1: Rough heel strikes + toe-offs |
| 7 | Walking Speed | Calculates median pelvis velocity for thresholds | Panel 3: Overall walking speed reference |
| 8 | Velocity Detective | Bonci refinement - uses speed spikes + adaptive thresholds | Panel 2: Final precise gait events (99% accuracy) |

| **Your Question** | **Panel Analysis Focus** | **Key Technical Details** |
| --- | --- | --- |
| What does this Bonci code do? | Code implements 2-panel comparison: Position-based (Panel 1) vs Velocity-based refinement (Panel 2) | Method M10: 99% accuracy gold standard, combines Zeni position method + velocity refinement with adaptive thresholds |
| Explain the panels | Panel 1 = position tracking, Panel 2 = speed detection | Motion capture: 100Hz sampling, tracks heel/toe markers in 3D space, detects foot-ground contact events |
| What am I seeing in Panel 2? Flat threshold lines? | Blue line= heel 3D velocity,Green line= toe 3D velocity,Flat dashed lines= adaptive speed thresholds | Adaptive thresholds: Toe = 0.8×walking speed (0.253 m/s), Heel = 0.5×walking speed (0.158 m/s) |
| Why aren't heel/toe events opposite like Panel 1? | Panel 1: Heel peaks UP, toe peaks DOWN (position extremes),Panel 2: Both peak UP (velocity spikes) | Position logic: Max forward/backward displacement,Velocity logic: Both create sudden movement spikes |
| Explain Panel 2 final detections | Red dots= final heel strikes on blue line,Orange squares= final toe-offs on green line | Two-step process: Step 1 = rough position guess, Step 2 = velocity refinement within ±15 frame window |
| Should red/orange be opposite in Panel 2? | NO- Shows correct walking sequence: Heel strike → Toe-off for same foot | Gait cycle: Heel contact first (0% cycle), toe push-off second (~60% cycle), temporal sequence not spatial |
| Analyze 10816-10818 sec - why red dot so high? | High red dotat ~3.0 m/s shows strong heel impact velocity peak | Impact physics: Heel decelerates from max speed to zero at ground contact, creates velocity spike |
| Why overlapping at 10824 in Panel 1? | Overlapping markersshow position-based detection limitations, timing errors | Double support phase: Brief period where both heel strike and toe-off occur close together (~10-20% step cycle) |
| You're wrong - they overlap in Panel 2 at 10816 too | Correct observation- Both panels show same rapid heel-to-toe transition | Gait variation: Quick ground contact time, normal biomechanical variation, both methods detect same real event |
| Why does Panel 1 give approximate events? | Position methoddetects marker location extremes, not actual contact moments | Timing mismatch: Position peaks ≠ ground contact timing, systematic 5-15ms delays, requires expert correction |