



Tempo and Onset Detection Limits

<https://musicreason.com/resources/tempo-and-onset-detection-limits/> · Last updated 2026-09-06

Detecting a tempo automatically means finding a periodic pattern in a sequence of note onsets. That pattern is real evidence, but rubato, sparse or dense note events, and simple arithmetic relationships between candidate tempos all limit how confidently a single number can be reported.

Half and double tempo are a structural ambiguity, not a rare bug

A steady beat at 120 BPM and one at 60 BPM can share many of the same periodic onset patterns, depending on which underlying subdivision a detector locks onto. This half/double relationship is a known limitation of onset-based tempo estimation in general, which is why a responsible detector reports its best candidate with a match score, not a single unqualified number.

Tap Tempo sidesteps detection entirely

Tap Tempo does not attempt automatic tempo detection from audio at all; it averages the intervals between your own manual taps, which avoids onset-detection ambiguity by relying on a human's own sense of the beat instead.

Note density changes how much onset evidence exists

A sparse, quiet passage offers a detector fewer clear onset events to build a tempo estimate from than a dense, rhythmically active one. Rhythm Pattern Generator and Groove Grid Explorer work from a known, generated rhythm rather than inferring one from an ambiguous real recording, which is a materially easier problem than blind tempo detection.

Onset and tempo detection is not beat tracking or transcription

Identifying likely event timings and a likely tempo is a narrower claim than full beat tracking, drum transcription, or music identification, none of which are implemented here. See Why Audio Recognition Is Ambiguous for the site-wide policy this specializes for rhythm.

Frequently asked questions

Why can an automatic tempo estimate land on exactly half or double the "real" tempo?

A steady beat at 120 BPM and one at 60 BPM can share many of the same periodic onset patterns depending on which subdivision the detector locks onto, which is why a half/double ambiguity is a known, structural limitation of onset-based tempo estimation, not a rare bug.

Does a tempo estimate use a percentage confidence?

Tempo and onset estimation on this site is reported as a match score against the detected periodicity, not a calibrated percentage confidence, matching the three-mode distinction in *Why Audio Recognition Is Ambiguous*.

Can this kind of tool transcribe a full drum part?

No. Onset and tempo estimation identifies when events likely occurred and a likely tempo; it does not attempt drum transcription or instrument identification, which are separate, unimplemented problems.

Where this shows up

RHYTHM AND TEMPO

Tap Tempo

RHYTHM AND TEMPO

Rhythm Pattern Generator

RHYTHM AND TEMPO

Groove Grid Explorer