SCORE FOLLOWING WITH HIDDEN TEMPO USING SWITCHING STATE-SPACE MODEL

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Introduction
What is Score Following?
The score-following problem involves building a computer program that can trace musical events in a given score during a live performance.

Why Score Following?
### 1. Kalman Filter Model for Tempo

- **Notation:**
  - $n_t$: tempo
  - $l_t$: onset
  - $f_t$: frame label
  - $a_t$: audio data

- **Objective:**
  - Smooth tempo
  - Approximation

- **Algorithm:**
  - **Initialization:**
    - Set initial state $n_0 = 1$, $l_0 = 0$
  - **Prediction:**
    - $n_{t+1} = n_t + \alpha (l_{t+1} - l_t)$
    - $l_{t+1} = l_t$
  - **Update:**
    - $n_{t+1} = n_{t+1} + \beta (a_t - n_{t+1})$

- **Observation:**
  - $a_t$ is the observed audio data at time $t$

- **Evaluation:**
  - **Comparison:**
    - *Baseline:* Music Plus One
    - *Proposed Method:* Robust with incorrect default tempo, recovers faster from mistakes, but suffers at fast playing places.

- **Conclusion:**
  - This paper presents an innovative new method for improved score-following and suggests a promising direction for future research endeavors.