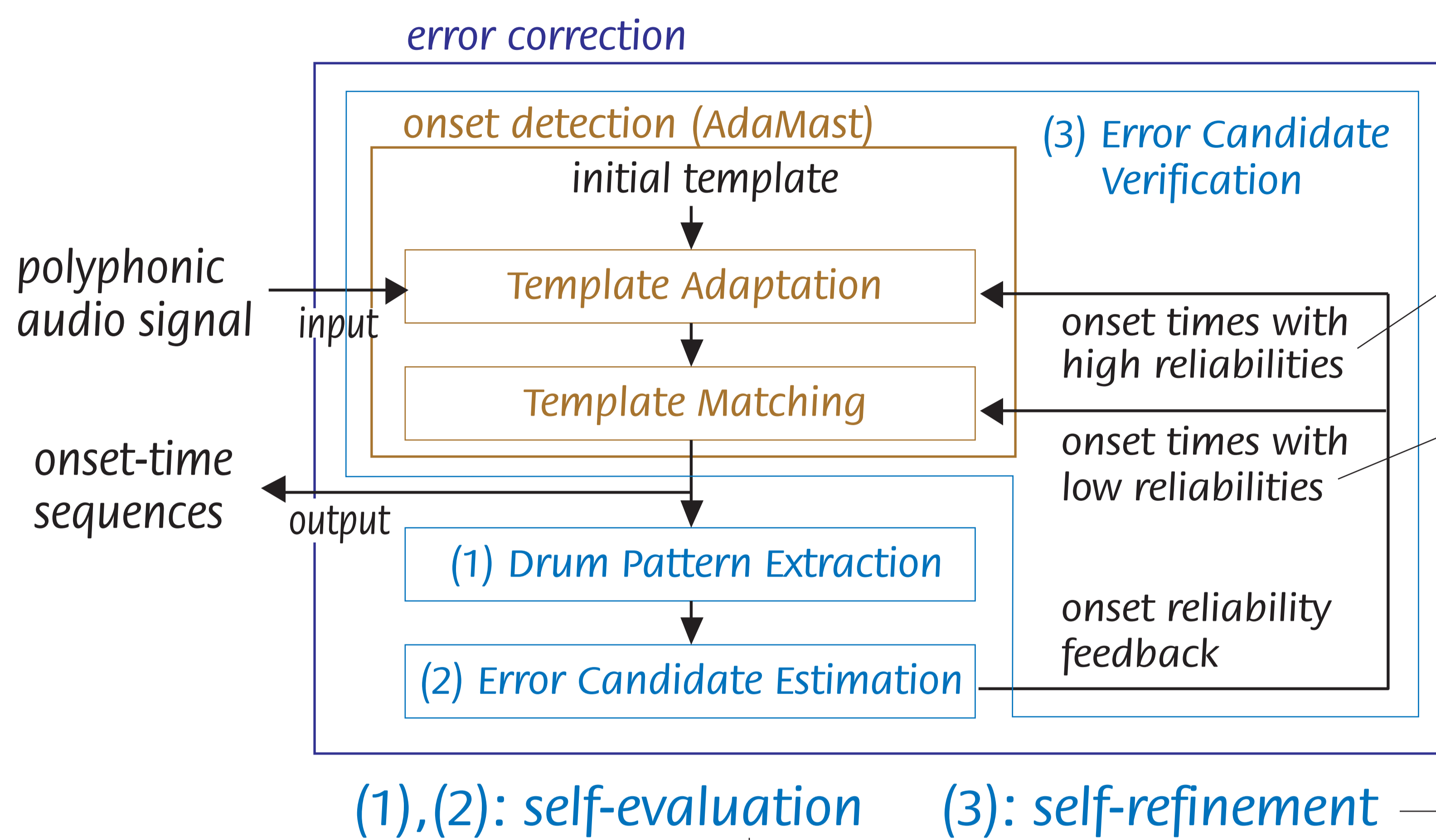


## Solution

- self-refinement architecture -

### Error correction with template-based drum sound detection

- Our template-based detection method, called **AdaMast** [yoshii2004], is used.
  - **Template Adaptation** for estimating an actual spectrogram of each drum  
An initial template is adapted iteratively to spectrograms extracted from highly-likely onsets.
  - **Template Matching** for detecting onset times of the drum  
The adapted template is compared with spectrograms extracted from all onset candidates.
- **Error candidate verification stage is implemented by rerunning AdaMast.**



### Self-refinement based on self-evaluation of outputs

- **Template Re-Adaptation** using spectrograms extracted from reliable onsets
- **Template Re-Matching** for verifying false-alarms and miss-hits

for false alarms: decrease the thresholds  
for misses: increase the thresholds  
**new criterion!**

(1),(2): self-evaluation (3): self-refinement (3) Error Candidate Verification

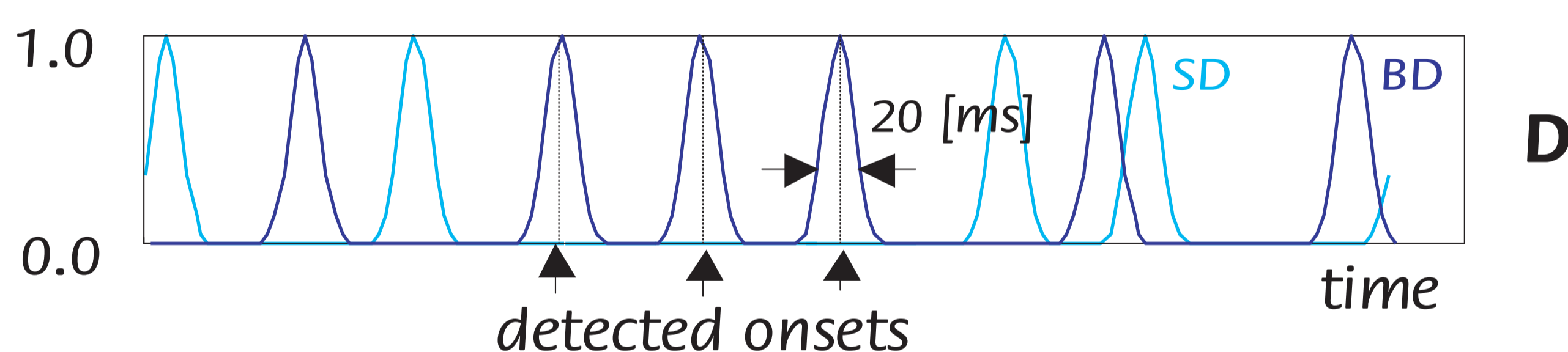
## Implementation

### (1) Drum Pattern Extraction

Lengths and start times of periodic patterns are estimated.

#### 1. Estimation of period lengths

##### 1.1 Gaussian (error margin model) allocation

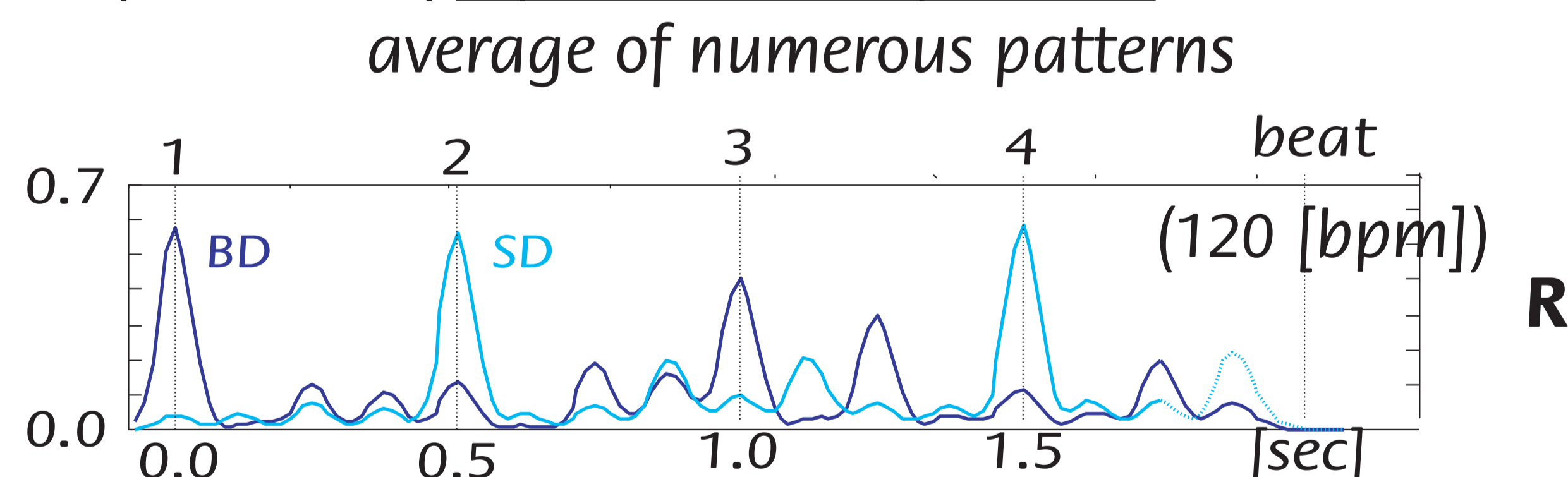


##### 1.2 STFT analysis for each onset distribution

##### 1.3 Estimation of period length by calculating a peak interval of a spectrum at each frame

#### 2. Estimation of start times

##### 2.1 Preparation of reference drum patterns



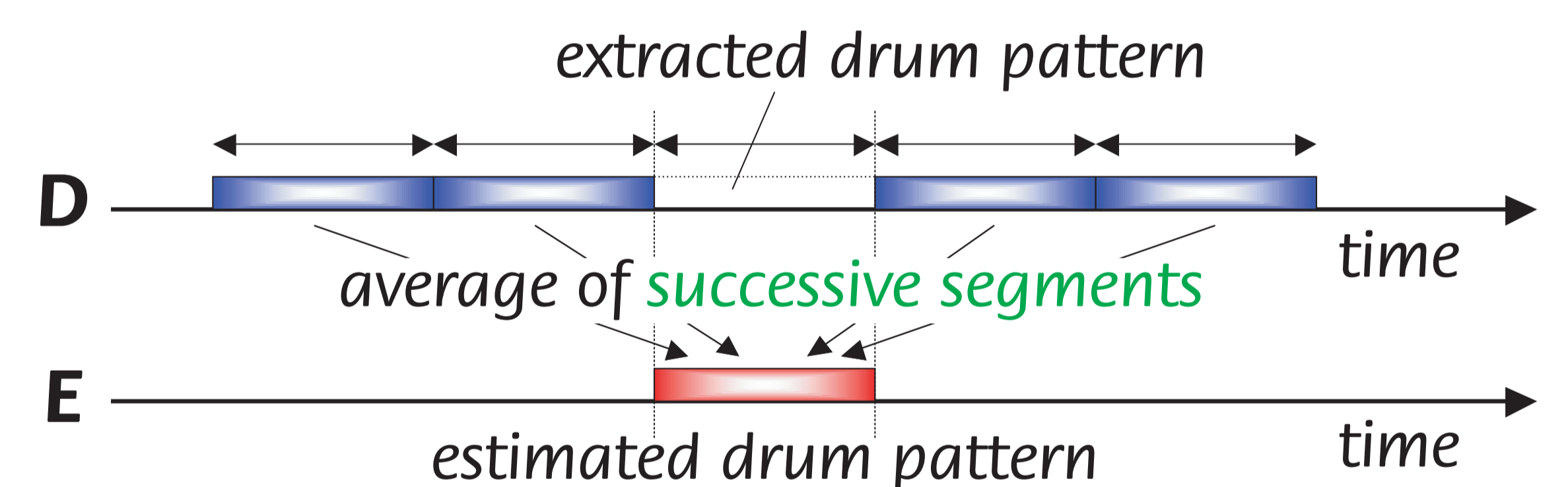
##### 2.2 Estimation of start times by picking times at which correlations between R and D are high enough

### (2) Error Candidate Estimation

Reliability of each onset is evaluated. Potential onset candidates are detected.

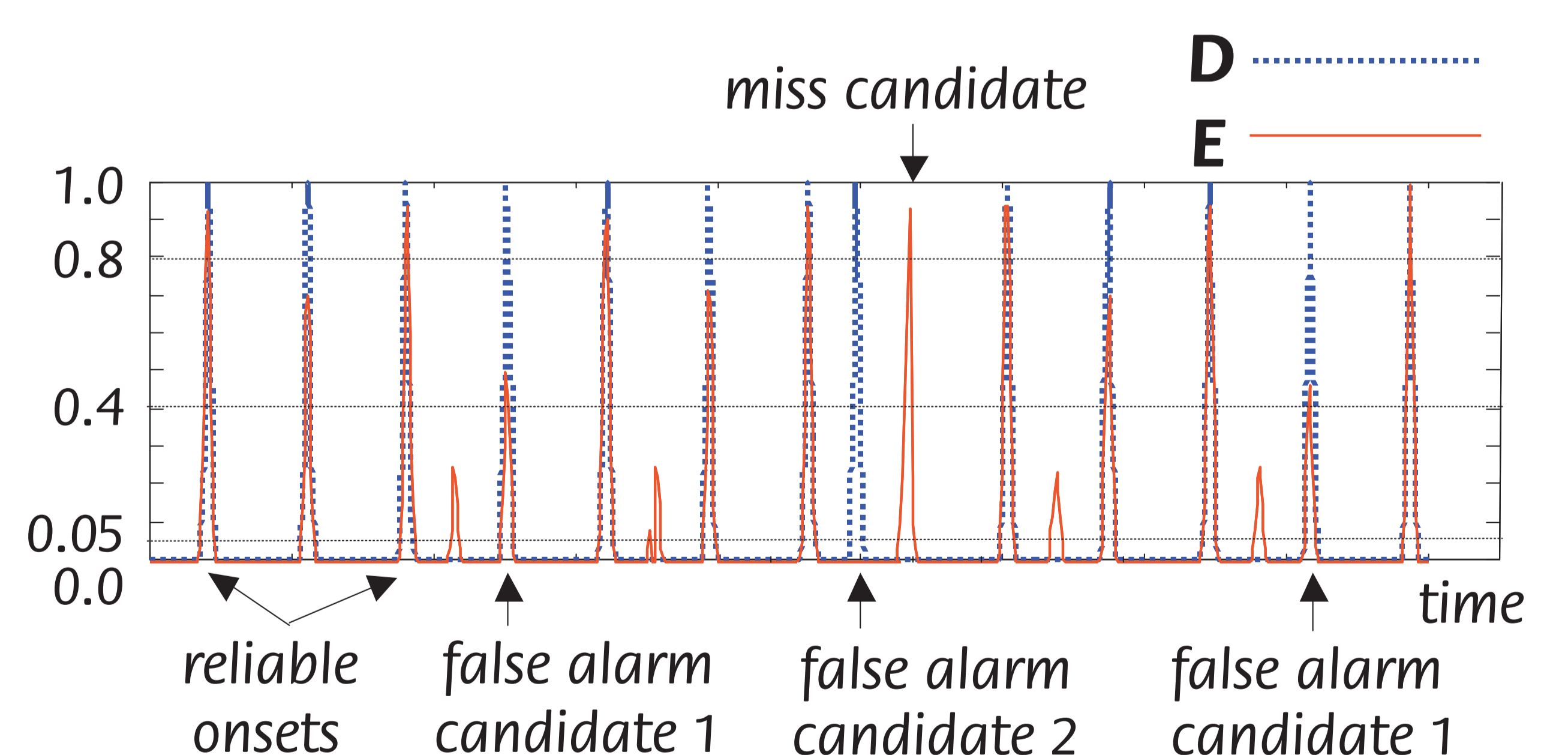
#### 1. Estimation of actual drum patterns

We assume that the same patterns are successive.



#### 2. Evaluation of onset reliabilities

Each onset is categorized into four reliability classes.



## Experiments

### Practical Testset: full CD-quality music

- 50 musical pieces are used in RWC-MDB-P-2001.

Test results (F-measures [%])

method	BD	SD	
TM	70.1	68.0	TA: template adaptation
TM+TA	<b>76.8</b>	<b>78.0</b>	TM: template matching
TM+TA+ECM	77.5	79.4	ECA: error correction via re-adaptation
TM+TA+ECA	80.6	79.3	ECM: error correction via re-matching
TM+TA+ECA+ECM	<b>81.1</b>	<b>80.3</b>	

## Conclusion

### Periodicity-based error correction framework

- We focus on higher-level content.

### Effectiveness of periodicity constraints

- We developed a template-based drum sound detection system with error correction functions.
- We confirmed that the error correction functions improve the onset detection accuracy.