

W. M. ...

Department of Mathematics, School of
Mathematics, Peking University, Beijing 100871, P.R.
China
jwma@math.pku.edu.cn

Abstract. ...

Keywords: ...

The image shows a musical score on a grand staff. The notation includes various notes, rests, and dynamic markings. Key markings include 'm' (mezzo-forte), 'b' (piano), 'c' (crescendo), 'ff' (fortissimo), and 'm' (mezzo-forte). The score is arranged in several systems, with some measures containing complex rhythmic patterns and some measures containing rests. The overall appearance is that of a handwritten or printed musical manuscript.

$$J \Theta_k = \frac{1}{N} \sum_{t=1}^N \sum_{j=1}^k \frac{\alpha_{jq} x_t | \theta_j}{\sum_{i=1}^k \alpha_{iq} x_t | \theta_j} \ln \alpha_{jq} x_t | \theta_j$$

$$\alpha_j^+ = \frac{\sum_{t=1}^N h_j t}{\sum_{i=1}^i \sum_{t=1}^N h_i t}$$

$$m_j^+ = \frac{\sum_{t=1}^N h_j t x_t}{\sum_{t=1}^N h_j t}$$

$$\Sigma_j^+ = \frac{\sum_{t=1}^N h_j t x_t x_t - \eta_j x_t - \eta_j^T}{\sum_{t=1}^N h_j t}$$

$w_{j,t} = h_j t \cdot p_j |x_t$ $\sum_{i=1}^k p_j |x_t \cdot \delta_{ij} - p_j |x_t \cdot \ln_j \alpha_i q x_t |m_i, \Sigma_i \cdot p_j |x_t$
 $\alpha_j q x_t |m_j, \Sigma_j / \sum_{i=1}^k \alpha_i q x_t |m_i, \Sigma_i \dots \delta_{ij}$

2.2 The Proposed Approach to Automatic Straight Line Detection

$\mathcal{B} = \{x_t\}_{t=1}^N$ $x_t = [x_{1,t}, x_{2,t}]^T$
 \mathcal{B} $\{ \alpha_i, m_i, \Sigma_i \}_{i=1}^k$
 $k \geq k^*$ k^*
 $\delta > \dots$
 \mathcal{B} $k \geq k^*$ k^* $\{ \alpha_i, m_i, \Sigma_i \}_{i=1}^k$
 m_i $V_{1,i}$ Σ_i α_i, m_i, Σ_i
 $V_{1,i} w_{1,i} U_{1,i}^T x - m_i$ $U_{1,i}$ $V_{1,i}$
 $U_{1,i}$ $V_{1,i}$
 $k > k^*$
 $\epsilon > \dots$ $\delta > \dots$
 \mathcal{B}

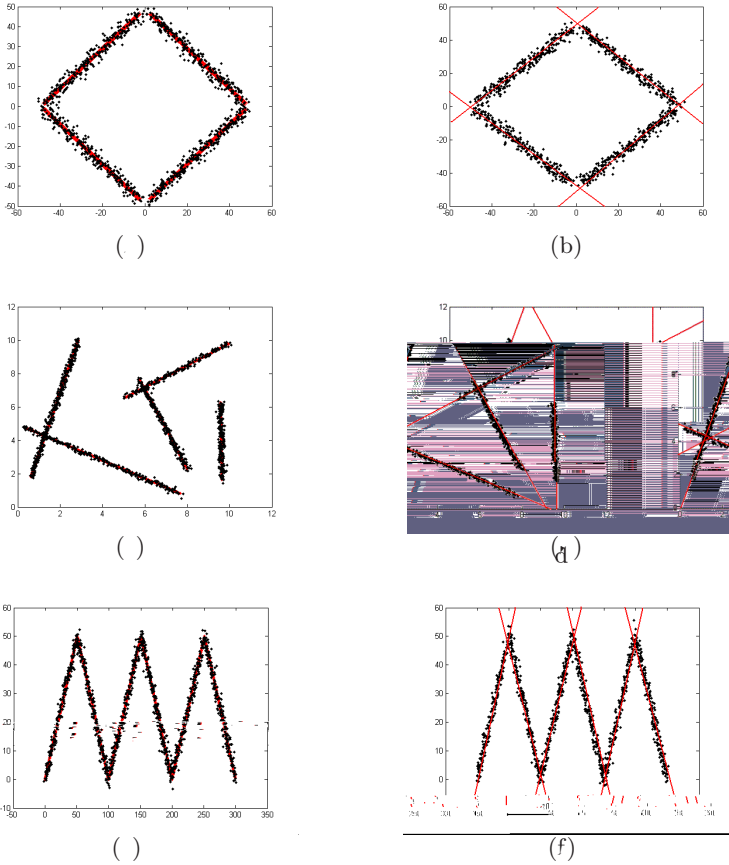


Fig. 1. (a) Scatter plot of data points forming a diamond shape. (b) Scatter plot of data points forming a diamond shape with red lines connecting the vertices. (c) Scatter plot of data points forming several parallel lines. (d) Scatter plot of data points forming several parallel lines with red lines connecting the vertices. (e) Scatter plot of data points forming a zigzag pattern. (f) Scatter plot of data points forming a zigzag pattern with red lines connecting the peaks and troughs.

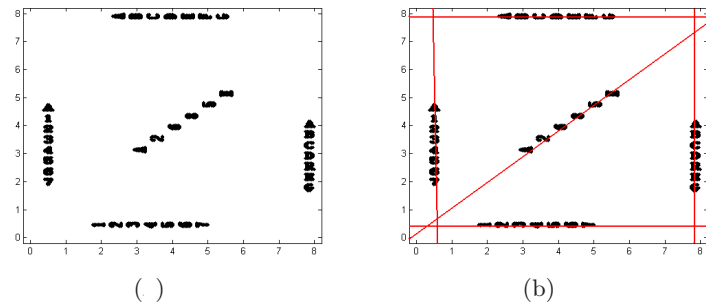


Fig. 2. (a) Scatter plot of data points forming a diagonal line with horizontal and vertical segments. (b) Scatter plot of data points forming a diagonal line with horizontal and vertical segments, overlaid with a red line forming a square.

b b m
 b m,b b b
 m,b w T w
 T m,b w m
 m,b m m
 w m m m
 m,b m,b A w b
 m,b w

