Multi-view classifier based on Probabilistic Collaborative Representation and Latent Representation

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Abstract:

Key Words:

1 Introduction

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2 ProCRC-MV and LProCRC-MV

2.1 Probabilistic Collaborative Representation based Classifier (ProCRC)

[3] $X = [X_1, \cdots, X_K]$, X_k, $k \in \{1, \cdots, K\}$ k, X_k, l_X X. S X, X x S, $x = X\alpha$, α x $l(x)$. $X\alpha$ S, $l(x)$, $P(l(x) \in l_X)$ α. $P(l(x) \in l_X)$ α

$$P(l(x) \in l_X) \propto \exp(-c\,\|\alpha\|_2^2) \qquad (1)$$

c y S, X y $l(x)$

$X\alpha$ x. h y, fi x S h h h

$$P(l(y) \in l_X) = P(l(y) = l(x) | l(x) \in l_X) \cdot P(l(x) \in l_X) \quad (2)$$

h h $P(l(y) = l(x) | l(x) \in l_X)$ h x x.

$$
\begin{bmatrix} y_{1,n_y} \\ y_{2,n_y} \\ \vdots \\ y_{m,n_y} \\ \vdots \\ y_{M,n_y} \end{bmatrix} = [x_1, x_2, \cdots, x_{n_X}, \cdots, x_{N_X}] \begin{bmatrix} \hat{\alpha}_{1,n_y} \\ \hat{\alpha}_{2,n_y n_y} \\ \vdots \\ \hat{\alpha}_{n_X,n_y} \\ \vdots \\ \hat{\alpha}_{N_X,n_y} \end{bmatrix}
$$

$$
= \hat{\alpha}_{1,n_y} \begin{bmatrix} x_{1,1} \\ x_{2,1} \\ \vdots \\ x_{m,1} \\ \vdots \\ x_{M,1} \end{bmatrix} + \cdots + \hat{\alpha}_{n_X,n_Y} \begin{bmatrix} x_{1,n_X} \\ x_{2,n_X} \\ \vdots \\ x_{m,n_X} \\ \vdots \\ x_{M,n_X} \end{bmatrix} + \cdots + \hat{\alpha}_{N_X,n_y} \begin{bmatrix} x_{1,N_X} \\ x_{2,N_X} \\ \vdots \\ x_{m,N_X} \\ \vdots \\ x_{M,N_X} \end{bmatrix} \tag{15}
$$

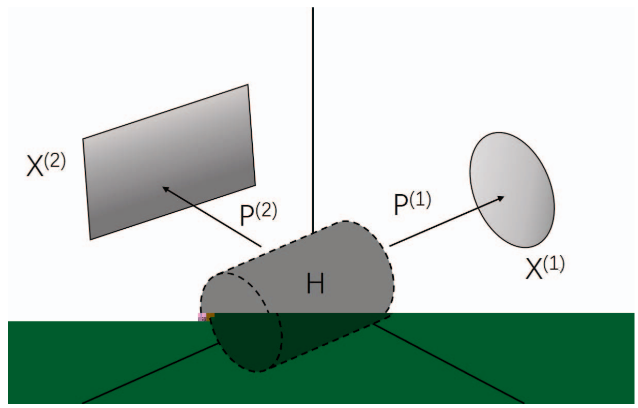
$$
\min_Z L(X, XZ) + \lambda \quad (Z) \tag{16}
$$

$L(\cdot)$ $(\cdot)$ $\lambda > 0$

3. 3. 20 20

X, X $X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^{N_X}$ N_X V $Y = \{[y_i^1, \cdots, y_i^V]\}_{i=1}^{N_Y}$ N_Y V

$X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^N$, N V 1. $P = \{p^1, \cdots, p^V\}$



1

$$
x_i^{(v)} = P^{(v)} h_i + e_i^{(v)} \quad (1\ )
$$

$e_i^{(v)}$

$$\min_{P,H,Z,E_V,E_S} \|E_V\|_{2,1} + \lambda_1 \|E_S\|_{2,1} + \lambda_2 \|Z\|_2 \quad s.t. X = PH + E_V, H = HZ + E_S, PP^T = I \tag{21}$$

L_2 Z [5].

(21) [20]. (21) [11]

$$\begin{aligned} &L(P,H,Z,E_V,E_S,J) \\ &= \|E\|_{2,1} + \lambda \|J\|_2 + \ (W_1, X - PH - E_V) \\ &+ \ (W_2, H - HZ - E_S) + \ (W_3, J - Z) \\ &s.t. E = [E_V; E_S]; \ PP^T = I \end{aligned} \tag{22}$$

J Z W_1, W_2, W_3 [20] $(C,D) = \frac{\mu}{2}\|D\|_F^2 + \langle C,D \rangle$, $\langle A,B \rangle = tr(A^T B)$, $\mu > 0$ C [11]

(1) P

$$P^* = \arg\min_P \ (W_1, X - PH - E_V) \quad s.t. PP^T = I \tag{23}$$

1 [16] $\min_R \|Q - GR\|_F^2, s.t. R^T R = RR^T = I$, $R = UV^T$, U V $G^T Q$. (23)

$$\begin{aligned} P^* &= \arg\min_P \ (W_1, X - PH - E_V) \\ &= \arg\min_P \tfrac{\mu}{2} \|X - PH - E_V + W_1/\mu\|_F^2 \\ &= \arg\min_P \tfrac{\mu}{2} \|(X + W_1/\mu - E_V) - PH\|_F^2 \\ &= \arg\min_P \tfrac{\mu}{2} \left\|(X + W_1/\mu - E_V)^T - H^T P^T\right\|_F^2 \end{aligned} \tag{24}$$

1 [16] $(P^*)^T = UV^T$, U V $H(X + W_1/\mu - E_V)^T$.

(2) H

$$H^* = \arg\min_H \ (W_1, X - PH - E_V) + \ (W_2, H - HZ - E_S) \tag{25}$$

H, 0,

$$AH + HB = C \tag{26}$$

$$A = \mu P^T P \tag{27}$$

$$B = \mu(ZZ^T - Z - Z^T + I) \tag{28}$$

$$\begin{aligned} C &= (P^T W_1 + W_2(Z^T - I)) \\ &+ \mu(P^T X + E_S^T - P^T E_V - E_S Z^T) \end{aligned} \tag{29}$$

(26) [22], (26), H^*.

(3) Z Z

$$Z^* = \arg\min_Z \ (W_3, J - Z) + \ (W_2, H - HZ - E_S) \tag{30}$$

$$\begin{aligned} Z^* &= (H^T H + I)^{-1}[(J + H^T H - H^T E_S) \\ &+ (W_3 + H^T W_2)/\mu] \end{aligned} \tag{31}$$

(4) E

$$\begin{aligned} E^* &= \arg\min_E \|E\|_{2,1} + \ (W_1, X - PH - E_V) \\ &+ \ (W_2, H - HZ - E_S) \\ &= \arg\min_E \tfrac{1}{\mu} \|E\|_{2,1} + \tfrac{1}{2} \|E - G\|_F^2 \end{aligned} \tag{32}$$

G $X - PH - W_1/\mu$ $H - HZ + W_2/\mu$. [12].

(5) J

$$\begin{aligned} J^* &= \arg\min_J \lambda \|J\|_* + \ (W_3, J - Z) \\ &= \tfrac{\lambda}{\mu} \|J\|_* + \tfrac{1}{2} \|J - (Z - W_3/\mu)\|_F^2 \end{aligned} \tag{33}$$

[2].

(6)

$$\begin{aligned} W_1 &= W_1 + \mu(X - PH - E_V) \\ W_2 &= W_2 + \mu(H - HZ - E_S) \\ W_3 &= W_3 + \mu(J - Z) \end{aligned} \tag{34}$$

1.

Algorithm 1

Input: $X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^N$, k H λ

1 $P = 0$, $E_V = 0$, $E_S = 0$, $J = Z = 0$, $W_1 = 0, W_2 = 0, W_3 = 0$, $\mu = 10^{-6}$, $\rho = 1.2$, $\varepsilon = 10^{-4}$, $\max_\mu = 10^6$, H

2 **repeat**

3 P, H, Z, E_V, E_S, J

4 W_1, W_2, W_3

5 μ $\mu = \min(\rho\mu; \max_\mu)$

6 $\|X - PH - E_V\|_\infty < \varepsilon$, $\left\|H - PH - E_{\setminus S}\right\|_\infty < \varepsilon$ $\|J - Z\|_\infty < \varepsilon$

until

Output: P, H, Z E

H, H

3 Experimental results

3.1 ProCRC-MV

$X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^{N_X}$ x_i $X^{M \times N_X} = [x_1, \cdots, x_{n_X}, \cdots, x_{N_X}]$, $n_X \in \{1, \cdots, N_X\}$. $Y = \{[y_i^1, \cdots, y_i^V]\}_{i=1}^{N_Y}$ y_i, $Y^{M \times N_Y} = [y_1, \cdots, y_{n_Y}, \cdots, y_{N_Y}]$, $n_Y \in \{1, \cdots, N_Y\}$, M $X^{M \times N_X}, Y^{M \times N_Y}$ $\{l_i\}_{i=1}^{N_X}$, $\{l_i\}_{i=1}^{N_Y}$

1

[illegible]	256	2	2016	8
[illegible]	96	3	64	6
[illegible]	400	3	3304 4096 6 50	40
[illegible]	685	4	4633 4659 4684 4665	5
[illegible]	195	2	585 1 03	5
[illegible]	18	2	561 1 03	5
[illegible]	265	2	95 1 03	5

15, 10,

2 3.

0.8 0.2

0.6 0.2 0.2.

1

1-

0.002, 2, 10

3.2 LProCRC-MV

$X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^{N}$ X $X = \{[x_i^1, \cdots, x_i^V]\}_{i=1}^{N_X}$ $Y = \{[y_i^1, \cdots, y_i^V]\}_{i=1}^{N_Y}$. H H

4 5.

4 5 1-

2 h (%)

h							
	88.9±3.4	9 .6±2.3	92.6±5.4	90.4±2.0	2.5±5.5	6. ±5.4	85.0±4.
	63.8±4.0	95.0±0.2	89.2±1.9	2.8±0.5	49.5± .4	69.2±4.3	51.4±3.8
	50.1±2.6	95.4±0.1	5 .5±0	3 .8±1.2	41.4±1.	58.0±1.	53.0±1.5
	33.5± .0	100±0	81.8±1.9	95.5±2.8	60. ±5.1	65.1±5.0	64.5±2.5
	98.6±1.3	100±0	98.6±1.3	96.1±1.	9.5±6.4	.3±6.1	8.5±5.0

3 1- h (%)

h							
	8 .9±3.8	9 .9±2.6	92.65±4.2	89.1±2.3	59.4±8.	61.8±11.5	69.4±9.
	62.5±4.	93.9±1.3	8 .0±3.0	1.2±0.1	32.9±6.2	49.1±5.0	3 .8±3.
	50.9±2.5	96.1±0.1	55.5±0	32.3±3.2	26.1±1.5	51.1±1.4	40.0±2.5
	32.2±5.9	100±0	84.2±2.2	93.4±6.4	42.8±4.6	53.6±8.5	.8±2.
	98. ±1.2	100±0	98. ±1.2	96.0±2.0	66.0±8.4	60.3± .5	66.0±8.4

4 h (%)

h							
	88.9±3.4	9 .6±2.3	92.6±5.4	90.4±2.0	2.5±5.5	6. ±5.4	85.0±4.
	63.8±4.0	95.0±0.2	89.2±1.9	2.8±0.5	49.5± .4	69.2±4.3	51.4±3.8
	50.1±2.6	95.4±0.1	5 .5±0	3 .8±1.2	41.4±1.	58.0±1.	53.0±1.5
	33.5± .0	100±0	81.8±1.9	95.5±2.8	60. ±5.1	65.1±5.0	64.5±2.5
	98.6±1.3	100±0	98.6±1.3	96.1±1.	9.5±6.4	.3±6.1	8.5±5.0
	95.5± .0	100±0	98.8±0.5	94.9±1.5	80.8±4.4	9.6±5.1	86.8±4.8

5 1- h (%)

h							
	8 .9±3.8	9 .9±2.6	92.65±4.2	89.1±2.3	59.4±8.	61.8±11.5	69.4±9.
	62.5±4.	93.9±1.3	8 .0±3.0	1.2±0.1	32.9±6.2	49.1±5.0	3 .8±3.
	50.9±2.5	96.1±0.1	55.5±0	32.3±3.2	26.1±1.5	51.1±1.4	40.0±2.5
	32.2±5.9	100±0	84.2±2.2	93.4±6.4	42.8±4.6	53.6±8.5	50.8±2.
	98. ±1.2	100±0	98. ±1.2	96.0±2.0	66.0±8.4	60.3± .5	66.0±8.4
	95.4± .	100±0	98.0±0.8	95.0±0.3	69.6±6.1	65.5±4.9	63.8±6.3

4 Conclusions and Discussion