Supplementary Material

(1) *Proof* of *Claim 1* in Lemma 2 (EDA):

Define $\mathcal{J}(\boldsymbol{\beta}^t, \boldsymbol{\Theta}^t, \mathbf{U}^t)$ as the joint objective function at iteration t. When fix $\boldsymbol{\Theta}^t$, there is

$$C_{\mathcal{S}}\|\mathbf{H}_{\mathcal{S}}\boldsymbol{\beta}^t - \mathbf{T}_{\mathcal{S}}\|_{\mathrm{F}}^2 + C_{\mathcal{T}}\|\mathbf{H}_{\mathcal{T}}\boldsymbol{\beta}^t - \mathbf{T}_{\mathcal{T}} \circ \boldsymbol{\Theta}^t\|_{\mathrm{F}}^2 + \gamma\|\boldsymbol{\Theta}^t - \mathbf{I}\|_{\mathrm{F}}^2 + \tau\left\|\mathbf{H}_{\mathcal{T}u}\boldsymbol{\beta}^t - \boldsymbol{\Phi}_{\wp,\mathcal{T}u}\right\|_{\mathrm{F}}^2 + \lambda \cdot tr((\boldsymbol{\beta}^t)^{\mathrm{T}}\mathbf{H}^{\mathrm{T}}\boldsymbol{\mathcal{L}}\mathbf{H}\boldsymbol{\beta}^t)$$

$$\geq$$

$$C_{\mathcal{S}}\|\mathbf{H}_{\mathcal{S}}\boldsymbol{\beta}^{t+1} - \mathbf{T}_{\mathcal{S}}\|_{\mathrm{F}}^2 + C_{\mathcal{T}}\|\mathbf{H}_{\mathcal{T}}\boldsymbol{\beta}^{t+1} - \mathbf{T}_{\mathcal{T}} \circ \boldsymbol{\Theta}^t\|_{\mathrm{F}}^2 + \gamma\|\boldsymbol{\Theta}^t - \mathbf{I}\|_{\mathrm{F}}^2 + \tau\left\|\mathbf{H}_{\mathcal{T}u}\boldsymbol{\beta}^{t+1} - \boldsymbol{\Phi}_{\wp,\mathcal{T}u}\right\|_{\mathrm{F}}^2 + \lambda \cdot tr((\boldsymbol{\beta}^{t+1})^{\mathrm{T}}\mathbf{H}^{\mathrm{T}}\boldsymbol{\mathcal{L}}\mathbf{H}\boldsymbol{\beta}^{t+1}) \quad (3.1)$$

Note that with fixed $\boldsymbol{\Theta}^t$, the model form a ℓ_2-norm based least square problem with respect to $\boldsymbol{\beta}$, which is always monotonically non-increasing. So, the inequality (3.1) holds.

According to (3), we know that $\|\boldsymbol{\beta}\|_{2,1} = \sum_{i=1}^{L}\|\boldsymbol{\beta}_i\|_2$, then the summation $\|\boldsymbol{\beta}^t\|_{2,1} + \sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_i^t\|_2^2}{2\|\boldsymbol{\beta}_i^t\|_2} - \|\boldsymbol{\beta}_i^t\|_2\right)$ is a constant. Therefore, there is

$$\|\boldsymbol{\beta}^t\|_{2,1} + \sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_i^t\|_2^2}{2\|\boldsymbol{\beta}_i^t\|_2} - \|\boldsymbol{\beta}_i^t\|_2\right) + C_{\mathcal{S}}\|\mathbf{H}_{\mathcal{S}}\boldsymbol{\beta}^t - \mathbf{T}_{\mathcal{S}}\|_{\mathrm{F}}^2 + C_{\mathcal{T}}\|\mathbf{H}_{\mathcal{T}}\boldsymbol{\beta}^t - \mathbf{T}_{\mathcal{T}} \circ \boldsymbol{\Theta}^t\|_{\mathrm{F}}^2 + \gamma\|\boldsymbol{\Theta}^t - \mathbf{I}\|_{\mathrm{F}}^2 + \tau\left\|\mathbf{H}_{\mathcal{T}u}\boldsymbol{\beta}^t - \boldsymbol{\Phi}_{\wp,\mathcal{T}u}\right\|_{\mathrm{F}}^2 + \lambda \cdot tr((\boldsymbol{\beta}^t)^{\mathrm{T}}\mathbf{H}^{\mathrm{T}}\boldsymbol{\mathcal{L}}\mathbf{H}\boldsymbol{\beta}^t)$$

$$\geq$$

$$\|\boldsymbol{\beta}^{t+1}\|_{2,1} + \sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_i^{t+1}\|_2^2}{2\|\boldsymbol{\beta}_i^t\|_2} - \|\boldsymbol{\beta}_i^{t+1}\|_2\right) + C_{\mathcal{S}}\|\mathbf{H}_{\mathcal{S}}\boldsymbol{\beta}^{t+1} - \mathbf{T}_{\mathcal{S}}\|_{\mathrm{F}}^2 + C_{\mathcal{T}}\|\mathbf{H}_{\mathcal{T}}\boldsymbol{\beta}^{t+1} - \mathbf{T}_{\mathcal{T}} \circ \boldsymbol{\Theta}^t\|_{\mathrm{F}}^2 + \gamma\|\boldsymbol{\Theta}^t - \mathbf{I}\|_{\mathrm{F}}^2 + \tau\left\|\mathbf{H}_{\mathcal{T}u}\boldsymbol{\beta}^{t+1} - \boldsymbol{\Phi}_{\wp,\mathcal{T}u}\right\|_{\mathrm{F}}^2 + \lambda \cdot tr((\boldsymbol{\beta}^{t+1})^{\mathrm{T}}\mathbf{H}^{\mathrm{T}}\boldsymbol{\mathcal{L}}\mathbf{H}\boldsymbol{\beta}^{t+1}) \quad (3.2)$$

According to **Lemma 1**, we know that

$$\sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_i^t\|_2^2}{2\|\boldsymbol{\beta}_i^t\|_2} - \|\boldsymbol{\beta}_i^t\|_2\right) \leq \sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_i^{t+1}\|_2^2}{2\|\boldsymbol{\beta}_i^t\|_2} - \|\boldsymbol{\beta}_i^{t+1}\|_2\right) \quad (3.3)$$

Therefore, combine (3.2) with (3.3), we can obtain that

$$\mathcal{J}(\boldsymbol{\beta}^t, \boldsymbol{\Theta}^t, \mathbf{U}^t) \geq \mathcal{J}(\boldsymbol{\beta}^{t+1}, \boldsymbol{\Theta}^t, \mathbf{U}^{t+1}) \quad (3.4)$$

Then, *Claim 1* is proven.

Note that $\mathbf{U}^t$ is completely determined when fix $\boldsymbol{\beta}^t$ according to (15), thus $\mathbf{U}^{t+1}$ is also determined when $\boldsymbol{\beta}^{t+1}$ is fixed.

(2) *Proof* of *Claim 2* in Lemma 2 (EDA):

When fix $\boldsymbol{\beta}^{t+1}$, $\mathbf{U}^{t+1}$ is also fixed, and the objective function is convex with respect to $\boldsymbol{\Theta}$. As can be seen from (18), the update rule of $\boldsymbol{\Theta}$ can be obtained by setting $\frac{\mathrm{d}\mathcal{J}(\boldsymbol{\beta}^{t+1},\boldsymbol{\Theta},\mathbf{U}^{t+1})}{\mathrm{d}\boldsymbol{\Theta}} = 0$, then there is

$$\frac{\mathrm{d}\mathcal{J}(\boldsymbol{\beta}^{t+1},\boldsymbol{\Theta},\mathbf{U}^{t+1})}{\mathrm{d}\boldsymbol{\Theta}} = -2C_{\mathcal{T}}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{H}_{\mathcal{T}}\boldsymbol{\beta}^{t+1} + 2C_{\mathcal{T}}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{T}_{\mathcal{T}}\boldsymbol{\Theta}^{t+1} + 2\gamma\boldsymbol{\Theta}^{t+1} - 2\gamma\mathbf{I} = 0 \quad (3.5)$$

Therefore, from (3.5) the update rule of $\boldsymbol{\Theta}$ is obtained as

$$\boldsymbol{\Theta}^{t+1} = \left(C_{\mathcal{T}}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{T}_{\mathcal{T}} + \gamma\mathbf{I}\right)^{-1}\left(C_{\mathcal{T}}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{H}_{\mathcal{T}}\boldsymbol{\beta}^{t+1} + \gamma\mathbf{I}\right) \quad (3.6)$$

Additionally, since the second order derivative of the objective function with respect to $\mathbf{\Theta}$ is

$$\frac{\mathrm{d}^2\mathcal{J}(\boldsymbol{\beta}^{t+1},\mathbf{\Theta},\mathbf{U}^{t+1})}{\mathrm{d}\mathbf{\Theta}^2} = 2C_{\mathcal{T}}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{T}_{\mathcal{T}} + 2\gamma > 0 \tag{3.7}$$

From (3.7), we know that the objective function is convex with respect to $\mathbf{\Theta}$, so the update rule (3.6) can minimize the objective function, there is

$$\mathcal{J}(\boldsymbol{\beta}^{t+1},\mathbf{\Theta}^{t},\mathbf{U}^{t+1}) \geq \mathcal{J}(\boldsymbol{\beta}^{t+1},\mathbf{\Theta}^{t+1},\mathbf{U}^{t+1}) \tag{3.8}$$

Then, *Claim 2* is proven.

(3) *Proof* of *Claim 3* in Lemma 2 (MvEDA):

The proof of *Claim 3* is similar with the proof of *Claim 1*, which is shown as follows.

Define $\mathcal{J}(\boldsymbol{\beta}_v^t,\mathbf{\Theta}_v^t,\alpha_v^t,\mathbf{U}_v^t)$ as the joint objective function at iteration *t*. When fix $\mathbf{\Theta}_v^t$, α_v^t, there is

$$C_{\mathcal{S}}\sum_{v=1}^{V}\alpha_v^t\left\|\mathbf{H}_{\mathcal{S},v}\boldsymbol{\beta}_v^t-\mathbf{T}_{\mathcal{S}}\right\|_{\mathrm{F}}^2 + C_{\mathcal{T}}\sum_{v=1}^{V}\alpha_v^t\left\|\mathbf{H}_{\mathcal{T},v}\boldsymbol{\beta}_v^t-\mathbf{T}_{\mathcal{T}}\circ\mathbf{\Theta}_v^t\right\|_{\mathrm{F}}^2 + \gamma\sum_{v=1}^{V}\alpha_v^t\|\mathbf{\Theta}_v^t-\mathbf{I}\|_{\mathrm{F}}^2 + \tau\sum_{v=1}^{V}\alpha_v^t\left\|\mathbf{H}_{\mathcal{T}u,v}\boldsymbol{\beta}_v^t - \boldsymbol{\phi}_{\wp,\mathcal{T}u}^{k,v}\right\|_{\mathrm{F}}^2 + \lambda\cdot\sum_{v=1}^{V}\alpha_{v,t}^{r}\, tr((\boldsymbol{\beta}_v^t)^{\mathrm{T}}\mathbf{H}_v^{\mathrm{T}}\boldsymbol{\mathcal{L}}_v\mathbf{H}_v\boldsymbol{\beta}_v^t)$$

$$\geq$$

$$C_{\mathcal{S}}\sum_{v=1}^{V}\alpha_v^t\left\|\mathbf{H}_{\mathcal{S},v}\boldsymbol{\beta}_v^{t+1}-\mathbf{T}_{\mathcal{S}}\right\|_{\mathrm{F}}^2 + C_{\mathcal{T}}\sum_{v=1}^{V}\alpha_v^t\left\|\mathbf{H}_{\mathcal{T},v}\boldsymbol{\beta}_v^{t+1}-\mathbf{T}_{\mathcal{T}}\circ\mathbf{\Theta}_v^t\right\|_{\mathrm{F}}^2 + \gamma\sum_{v=1}^{V}\alpha_v^t\|\mathbf{\Theta}_v^t-\mathbf{I}\|_{\mathrm{F}}^2 + \tau\sum_{v=1}^{V}\alpha_v^t\left\|\mathbf{H}_{\mathcal{T}u,v}\boldsymbol{\beta}_v^{t+1} - \boldsymbol{\phi}_{\wp,\mathcal{T}u}^{k,v}\right\|_{\mathrm{F}}^2 + \lambda\cdot\sum_{v=1}^{V}\alpha_{v,t}^{r}\, tr((\boldsymbol{\beta}_v^{t+1})^{\mathrm{T}}\mathbf{H}_v^{\mathrm{T}}\boldsymbol{\mathcal{L}}_v\mathbf{H}_v\boldsymbol{\beta}_v^{t+1}) \tag{4.1}$$

Note that with fixed $\mathbf{\Theta}_v^t$, α_v^t, the model form a ℓ_2-norm based least square problem with respect to $\boldsymbol{\beta}$, which is always monotonically non-increasing. So, the inequality (4.1) holds.

According to (3), we know that $\sum_{v=1}^{V}\|\boldsymbol{\beta}_v\|_{2,1} = \sum_{v=1}^{V}\sum_{i=1}^{L}\left\|\boldsymbol{\beta}_{i,v}\right\|_2$, then the summation $\sum_{v=1}^{V}\|\boldsymbol{\beta}_v^t\|_{2,1} + \sum_{v=1}^{V}\sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_{i,v}^t\|_2^2}{2\left\|\boldsymbol{\beta}_{i,v}^t\right\|_2} - \left\|\boldsymbol{\beta}_{i,v}^t\right\|_2\right)$ is a constant. Therefore, there is

$$\sum_{v=1}^{V}\|\boldsymbol{\beta}_v^t\|_{2,1} + \sum_{v=1}^{V}\sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_{i,v}^t\|_2^2}{2\|\boldsymbol{\beta}_{i,v}^t\|_2} - \left\|\boldsymbol{\beta}_{i,v}^t\right\|_2\right) + \sum_{v=1}^{V}C_{\mathcal{S}}\alpha_v^t\left\|\mathbf{H}_{\mathcal{S},v}\boldsymbol{\beta}_v^t-\mathbf{T}_{\mathcal{S}}\right\|_{\mathrm{F}}^2 + \sum_{v=1}^{V}C_{\mathcal{T}}\alpha_v^t\left\|\mathbf{H}_{\mathcal{T},v}\boldsymbol{\beta}_v^t-\mathbf{T}_{\mathcal{T}}\circ\mathbf{\Theta}_v^t\right\|_{\mathrm{F}}^2 + \sum_{v=1}^{V}\gamma\alpha_v^t\|\mathbf{\Theta}_v^t-\mathbf{I}\|_{\mathrm{F}}^2 + \sum_{v=1}^{V}\tau\alpha_v^t\left\|\mathbf{H}_{\mathcal{T}u,v}\boldsymbol{\beta}_v^t - \boldsymbol{\phi}_{\wp,\mathcal{T}u}^{k,v}\right\|_{\mathrm{F}}^2 + \lambda\cdot\sum_{v=1}^{V}\alpha_{v,t}^{r}\, tr((\boldsymbol{\beta}_v^t)^{\mathrm{T}}\mathbf{H}_v^{\mathrm{T}}\boldsymbol{\mathcal{L}}_v\mathbf{H}_v\boldsymbol{\beta}_v^t)$$

$$\geq$$

$$\sum_{v=1}^{V}\|\boldsymbol{\beta}_v^{t+1}\|_{2,1} + \sum_{v=1}^{V}\sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_{i,v}^{t+1}\|_2^2}{2\|\boldsymbol{\beta}_{i,v}^{t+1}\|_2} - \left\|\boldsymbol{\beta}_{i,v}^{t+1}\right\|_2\right) + \sum_{v=1}^{V}C_{\mathcal{S}}\alpha_v^t\left\|\mathbf{H}_{\mathcal{S},v}\boldsymbol{\beta}_v^{t+1}-\mathbf{T}_{\mathcal{S}}\right\|_{\mathrm{F}}^2 + \sum_{v=1}^{V}C_{\mathcal{T}}\alpha_v^t\left\|\mathbf{H}_{\mathcal{T},v}\boldsymbol{\beta}_v^{t+1}-\mathbf{T}_{\mathcal{T}}\circ\mathbf{\Theta}_v^t\right\|_{\mathrm{F}}^2 + \sum_{v=1}^{V}\gamma\alpha_v^t\|\mathbf{\Theta}_v^t-\mathbf{I}\|_{\mathrm{F}}^2 + \sum_{v=1}^{V}\tau\alpha_v^t\left\|\mathbf{H}_{\mathcal{T}u,v}\boldsymbol{\beta}_v^{t+1} - \boldsymbol{\phi}_{\wp,\mathcal{T}u}^{k,v}\right\|_{\mathrm{F}}^2 + \lambda\cdot\sum_{v=1}^{V}\alpha_{v,t}^{r}\, tr((\boldsymbol{\beta}_v^{t+1})^{\mathrm{T}}\mathbf{H}_v^{\mathrm{T}}\boldsymbol{\mathcal{L}}_v\mathbf{H}_v\boldsymbol{\beta}_v^{t+1} \tag{4.2}$$

According to **Lemma 1**, we know that

$$\sum_{v=1}^{V}\sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_{i,v}^t\|_2^2}{2\|\boldsymbol{\beta}_{i,v}^t\|_2} - \left\|\boldsymbol{\beta}_{i,v}^t\right\|_2\right) \leq \sum_{v=1}^{V}\sum_{i=1}^{L}\left(\frac{\|\boldsymbol{\beta}_{i,v}^{t+1}\|_2^2}{2\|\boldsymbol{\beta}_{i,v}^t\|_2} - \left\|\boldsymbol{\beta}_{i,v}^{t+1}\right\|_2\right) \tag{4.3}$$

Therefore, combine (4.2) with (4.3), we can obtain that

$$\mathcal{J}(\boldsymbol{\beta}_v^t,\mathbf{\Theta}_v^t,\alpha_v^t,\mathbf{U}_v^t) \geq \mathcal{J}(\boldsymbol{\beta}_v^{t+1},\mathbf{\Theta}_v^t,\alpha_v^t,\mathbf{U}_v^{t+1}) \tag{4.4}$$

Then, *Claim 3* is proven.

Note that $\mathbf{U}_v^t$ is completely determined when fix $\boldsymbol{\beta}_v^t$ according to (15), thus $\mathbf{U}_v^{t+1}$ is also determined when $\boldsymbol{\beta}_v^{t+1}$ is fixed.

(4) *Proof* of *Claim 4* in Lemma 2 (MvEDA):

The proof of *Claim 4* is similar with the proof of *Claim 2*.

When fix $\boldsymbol{\beta}_v^{t+1}$, $\mathbf{U}_v^{t+1}$ is also fixed, and the objective function is convex with respect to $\boldsymbol{\Theta}_v$. As can be seen from (29), the update rule of $\boldsymbol{\Theta}_v$ can be obtained by setting $\frac{\mathrm{d}\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v,\alpha_v^{t+1},\mathbf{U}_v^{t+1})}{\mathrm{d}\boldsymbol{\Theta}_v}=0$, then there is

$$\frac{\mathrm{d}\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v,\alpha_v^{t+1},\mathbf{U}_v^{t+1})}{\mathrm{d}\boldsymbol{\Theta}_v}=-2C_{\mathcal{T}}\alpha_v^{t+1}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{H}_{\mathcal{T},v}\boldsymbol{\beta}_v^{t+1}+2C_{\mathcal{T}}\alpha_v^{t+1}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{T}_{\mathcal{T}}\boldsymbol{\Theta}_v^{t+1}+2\gamma\alpha_v^{t+1}\boldsymbol{\Theta}_v^{t+1}-2\gamma\alpha_v^{t+1}\mathbf{I}=0 \quad (4.5)$$

Therefore, from (3.5) the update rule of $\boldsymbol{\Theta}_v$ is obtained as

$$\boldsymbol{\Theta}_v^{t+1}=\left(C_{\mathcal{T}}\alpha_v^{t+1}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{T}_{\mathcal{T}}+\gamma\alpha_v^{t+1}\mathbf{I}\right)^{-1}\left(C_{\mathcal{T}}\alpha_v^{t+1}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{H}_{\mathcal{T},v}\boldsymbol{\beta}_v^{t+1}+\gamma\alpha_v^{t+1}\mathbf{I}\right) \quad (4.6)$$

Additionally, since the second order derivative of the objective function with respect to $\boldsymbol{\Theta}_v$ is

$$\frac{\mathrm{d}^2\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v,\alpha_v^{t+1},\mathbf{U}_v^{t+1})}{\mathrm{d}{\boldsymbol{\Theta}_v}^2}=2C_{\mathcal{T}}\alpha_v^{t+1}\mathbf{T}_{\mathcal{T}}^{\mathrm{T}}\mathbf{T}_{\mathcal{T}}+2\gamma\alpha_v^{t+1}>0\ \ (\alpha_v>0) \quad (4.7)$$

From (4.7), we know that the objective function is convex with respect to $\boldsymbol{\Theta}$, so the update rule (4.6) can minimize the objective function, there is

$$\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v^{t},\alpha_v^{t},\mathbf{U}_v^{t+1})\geq\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v^{t+1},\alpha_v^{t},\mathbf{U}_v^{t+1}) \quad (4.8)$$

Then, *Claim 4* is proven.

(5) *Proof* of *Claim 5* in Lemma 3 (MvEDA).

As can be seen from (31), the update rule of α_v is obtained by setting $\frac{\mathrm{d}\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v^{t+1},\alpha_v,\mathbf{U}_v^{t+1},\eta)}{\mathrm{d}\alpha_v}=0$ and $\frac{\mathrm{d}\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v^{t+1},\alpha_v,\mathbf{U}_v^{t+1},\eta)}{\mathrm{d}\eta}=0$. Additionally, when r is set as 2, the 2nd order derivative of the objective function with respect to α_v is

$$\frac{\mathrm{d}^2\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v^{t+1},\alpha_v,\mathbf{U}_v^{t+1},\eta)}{\mathrm{d}\alpha_v^2}=2\cdot tr(\boldsymbol{\beta}_v^T\mathbf{H}_v^T\boldsymbol{\mathcal{L}}_v\mathbf{H}_v\boldsymbol{\beta}_v)\geq 0 \quad (4.9)$$

Therefore, we know that the objective function is convex with respect to α_v, there is

$$\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v^{t+1},\alpha_v^{t},\mathbf{U}_v^{t+1})\geq\mathcal{J}(\boldsymbol{\beta}_v^{t+1},\boldsymbol{\Theta}_v^{t+1},\alpha_v^{t+1},\mathbf{U}_v^{t+1}) \quad (4.10)$$

Then, *Claim 5* is proven.