Algorithm 1: component matrices computing

Input: $\mathcal{X} \in \mathbb{R}^{l_1 \times l_2 \times \cdots \times l_N}, \varepsilon, \lambda, \delta, R$

Output: $A^{(j)}s$ for $j = 1$ to N

Initialize all $A^{(j)}s$ //which can be seen as the 0^{th} round iterations;

$l'' = L$ //if we need to judge whether (11) is true then l'' denotes $L|_{t-1}$;

for *each* $A^{j}_{i_j r} (1 \leq j \leq N, 1 \leq i_j \leq I_j, 1 \leq r \leq R)$ **do**

  //1^{st} round iterations;

  $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$;

  $A^{(j)'}_{i_j r} = A^{(j)}_{i_j r}$//if the rollback shown as (12) is needed,$A^{(j)'}_{i_j r}$ denotes $A^{(j)}_{i_j r}|_{t-1}$;

  $A^{(j)}_{i_j r} = A^{(j)}_{i_j r} - \mathbf{sign}\left(g^{(j)}_{i_j r}\right) \cdot \delta^{(j)}_{i_j r}$;

repeat//other rounds of iterations for computing component matrices

  $l' = L$ //if we need to judge whether (11) is true then l' denotes $L|_t$;

  for *each* $A^{j}_{i_j r} (1 \leq j \leq N, 1 \leq i_j \leq I_j, 1 \leq r \leq R)$ **do**

    if $g^{(j)}_{i_j r} \cdot g^{(j)'}_{i_j r} > 0$ **then**

      $A^{(j)'}_{i_j r} = A^{(j)}_{i_j r}$;

      $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$;

      $\delta^{(j)}_{i_j r} = \mathbf{min}\left(\delta^{(j)}_{i_j r} \cdot \eta^{+}, Max\_Step\_Size\right)$;

      $A^{(j)}_{i_j r} = A^{(j)}_{i_j r} - \mathbf{sign}\left(g^{(j)}_{i_j r}\right) \cdot \delta^{(j)}_{i_j r}$;

    else if $g^{(j)}_{i_j r} \cdot g^{(j)'}_{i_j r} < 0$ **then**

      if $l' > l''$ **then**

        $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$;

        $A^{(j)}_{i_j r} = A^{(j)'}_{i_j r}$// if (11) is true then rollback as (12);

        $\delta^{(j)}_{i_j r} = \mathbf{max}\left(\delta^{(j)}_{i_j r} \times \eta^{-}, Min\_Step\_Size\right)$;

      else

        $A^{(j)'}_{i_j r} = A^{(j)}_{i_j r}$;

        $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$;

        $\delta^{(j)}_{i_j r} = \mathbf{max}\left(\delta^{(j)}_{i_j r} \cdot \eta^{-}, Min\_Step\_Size\right)$;

        $A^{(j)}_{i_j r} = A^{(j)}_{i_j r} - \mathbf{sign}\left(g^{(j)}_{i_j r}\right) \cdot \delta^{(j)}_{i_j r}$;

    else

      $A^{(j)'}_{i_j r} = A^{(j)}_{i_j r}$;

      $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$;

      $A^{(j)}_{i_j r} = A^{(j)}_{i_j r} - \mathbf{sign}\left(g^{(j)}_{i_j r}\right) \cdot \delta^{(j)}_{i_j r}$;

  $l'' = l'$;

until $\boldsymbol{L \leq \varepsilon}$ *or maximum iterations exhausted*;