Algorithm *Preconditioned Conjugate Gradient*

1: $\boldsymbol{r_0} = \boldsymbol{b} - \boldsymbol{A}\boldsymbol{x_0}$

2: $\widetilde{\boldsymbol{r}}_{\boldsymbol{0}} = \boldsymbol{L^{-1}}\boldsymbol{L^{-T}}\boldsymbol{r_0}$

3: $\boldsymbol{p_0} = \widetilde{\boldsymbol{r}}_{\boldsymbol{0}}$

4: **for** $i = 0, 1, ...$ until convergence **do**

5: $\quad \alpha = \dfrac{\overbrace{(\boldsymbol{r_i}, \widetilde{\boldsymbol{r}}_{\boldsymbol{i}})}^{\delta_i}}{(\underbrace{\boldsymbol{A}\boldsymbol{p_i}}_{\boldsymbol{t}}, \boldsymbol{p_i})}$

6: $\quad \boldsymbol{x_{i+1}} = \boldsymbol{x_i} + \alpha \boldsymbol{p_i}$

7: $\quad \boldsymbol{r_{i+1}} = \boldsymbol{r_i} - \alpha \underbrace{\boldsymbol{A}\boldsymbol{p_i}}_{\boldsymbol{t}}$

8: $\quad$ check the convergence of $\boldsymbol{r_{i+1}}$. If converge, **return**

9: $\quad \widetilde{\boldsymbol{r}}_{\boldsymbol{i+1}} = \boldsymbol{M^{-1}}\boldsymbol{r_{i+1}} = \boldsymbol{L^{-1}}\boldsymbol{L^{-T}}\boldsymbol{r_{i+1}}$

10: $\quad \beta = \dfrac{\overbrace{(\boldsymbol{r_{i+1}}, \widetilde{\boldsymbol{r}}_{\boldsymbol{i+1}})}^{\delta_{i+1}}}{\underbrace{(\boldsymbol{r_i}, \widetilde{\boldsymbol{r}}_{\boldsymbol{i}})}_{\delta_i}}$

11: $\quad \boldsymbol{p_{i+1}} = \widetilde{\boldsymbol{r}}_{\boldsymbol{i+1}} + \beta \boldsymbol{p_i}$

12: **end for**