Algorithm Preconditioned BiCGStab

1:
$$r_0 = b - Ax_0$$

2: for i = 1, 2, ... until convergence do

3: if
$$i == 1$$
 then

4:
$$p_i = r_{i-1}$$

5:

6:
$$\beta = \underbrace{(\overline{r_0}, r_{i-1})}_{\delta_{i-1}} \cdot \frac{\alpha_{i-1}}{\omega_{i-1}}$$

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$$\beta = \underbrace{\frac{\delta_{i}}{(\overline{r_{0}}, r_{i-1})}}_{\delta_{i-1}} \cdot \underbrace{\frac{\alpha_{i-1}}{\omega_{i-1}}}_{\delta_{i-1}}$$
7:
$$p_{i} = r_{i-1} + \beta(p_{i-1} - \omega_{i-1} \underbrace{A\widetilde{p}_{i-1}}_{v_{i-1}}) \qquad \triangleright p_{i} \neq 0$$
8: and if

9:
$$\widetilde{p}_i = M^{-1}p_i = M_U^{-1}M_L^{-1}p_i$$

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10: $\alpha_i = \underbrace{(\overline{r}_0, r_{i-1})}_{v_i}$
11: $x_i = x_{i-1} + \alpha_i \widetilde{p}_i$

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12:
$$s = r_{i-1} - \alpha_i \underbrace{A\widetilde{p_i}}_{v_i}$$
13: check the convergence of s . If converge, return

13:

14:
$$\widetilde{s} = M_U^{-1} M_L^{-1} s$$

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15: $\omega_i = \frac{(A\widetilde{s}, s)}{(A\widetilde{s}, \underbrace{A\widetilde{s}})}$ $\triangleright omega \neq 0$
16: $x_i = x_i + \omega_i \widetilde{s}$

16:
$$x_i = x_i + \omega_i \hat{s}$$

17:
$$r_i = s - \omega_i \underbrace{A\widetilde{s}}_t$$

check the convergence of r_i . If converge, return 18:

19: end for