



$\phi_G$  is enforced:

$$\phi_D = \frac{\phi_G + \phi_c}{2} \rightarrow \phi_G = 2\phi_D - \phi_c$$

Using an extended stencil,

$$\varphi_{n_1} = \frac{\frac{\varphi_c}{\|r_{n_1} - r_c\|} + \frac{\varphi_o}{\|r_{n_1} - r_{f_N}\|} + \frac{\varphi_o}{\|r_{n_1} - r_{f_c}\|} + \frac{\varphi_N}{\|r_{n_1} - r_N\|}}{\frac{\varphi_c}{\|r_{n_1} - r_c\|} + \frac{\varphi_o}{\|r_{n_1} - r_f\|} + \frac{\varphi_o}{\|r_{n_1} - r_f\|} + \frac{\varphi_N}{\|r_{n_1} - r_N\|}}$$

Then

$$(\nabla \varphi)_{f_c} = \frac{1}{\text{Volume of } \mathcal{L}} \sum_{k \in \{G, \mathcal{L}, n_1, n_2\}} \varphi_k \vec{S}_k$$