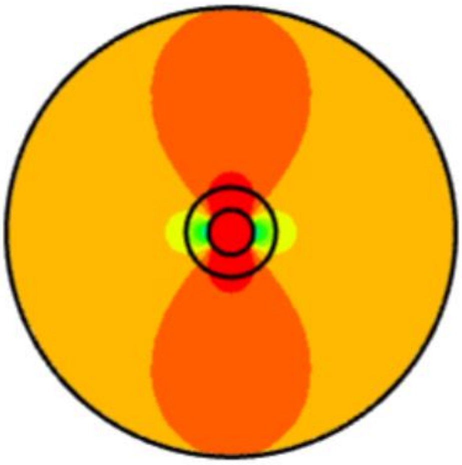

静磁場方程式

$$\nabla \cdot \boldsymbol{B} = 0, \qquad \boldsymbol{B} = \mu \boldsymbol{H}, \qquad \nabla \times \boldsymbol{H} = 0 \tag{1}$$

磁気スカラポテンシャル

$$\boldsymbol{H} = \nabla \omega \tag{2}$$

支配方程式

$$\nabla \cdot \mu \nabla \omega = 0 \quad in\ \Omega \tag{3}$$

境界条件

$$\begin{aligned} &\omega = \omega_s \quad on\ \ \Gamma_D \\ &\mu \nabla \omega \cdot \boldsymbol{n} = \boldsymbol{B} \cdot \boldsymbol{n} = B_s \ \ on\ \Gamma_N \\ &\Gamma_D + \Gamma_N = \partial \Omega \end{aligned} \tag{4}$$

重み付き残差法

$$\begin{aligned} &W = -\int_\Omega \psi \nabla \cdot \mu \nabla \omega = \int_\Omega \nabla \psi \cdot \mu \nabla \omega - \int_\Omega \nabla \cdot \left(\psi \mu \nabla \omega \right) \\ &= \int_\Omega \nabla \psi \cdot \mu \nabla \omega - \int_{\partial \Omega} \boldsymbol{n} \cdot \left(\psi \mu \nabla \omega \right) \\ &= \int_\Omega \nabla \psi \cdot \mu \nabla \omega - \int_{\Gamma_N} \psi B_s \\ &\psi = 0 \ \ on\ \Gamma_D \end{aligned} \tag{5}$$

離散化

$$\omega = \sum_{n\in\Omega} \omega_n N_n + \sum_{n\in\Gamma_N} \omega_n N_n + \sum_{n\in\Gamma_D} \omega_{sn} N_n$$

$$\psi = N_m,\ m \in \Omega + \Gamma_N$$

$$W = \int_\Omega \nabla\psi \cdot \mu\nabla\omega - \int_{\Gamma_N} \psi B_s$$

$$= \sum_{n\in\Omega+\Gamma_N} \omega_n \int_\Omega \nabla N_m \cdot \mu\nabla N_n + \sum_{n\in\Gamma_D} \omega_{sn} \int_\Omega \nabla N_m \cdot \mu\nabla N_n - \int_{\Gamma_N} N_m B_s$$

$$\sum_{n\in\Omega+\Gamma_N} \omega_n \int_\Omega \nabla N_m \cdot \mu\nabla N_n = \int_{\Gamma_N} N_m B_s - \sum_{n\in\Gamma_D} \omega_{sn} \int_\Omega \nabla N_m \cdot \mu\nabla N_n$$