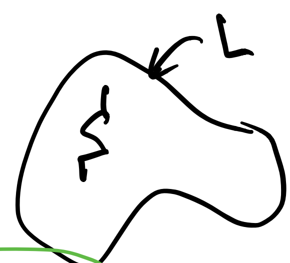
In the Main.m, we have

```
val_Hz = eig(A,B);
val_Ez = eig(A_mat,B_mat);
```

that correspond to

$$\begin{cases} -\nabla^2 H_z = k_t^2 \, 1 \, H_z & \text{in } S \\ \hat{n}\cdot\nabla H_z = 0 & \text{on } L \end{cases}$$

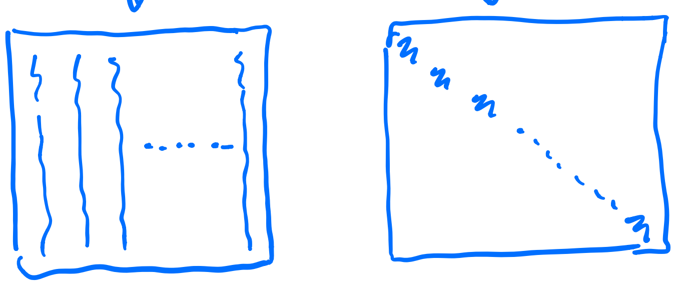


$$\Rightarrow \mathbb{A}\,\mathbb{h} = k_t^2\,\mathbb{B}\,\mathbb{h}$$

$$H_z(x,y) = \sum_{j=1}^{N} h_j \varphi_j(x,y)$$

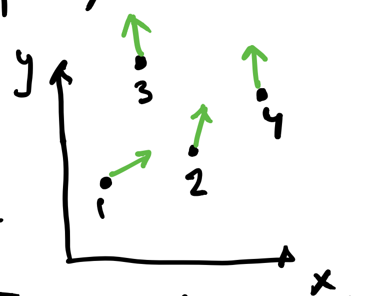
with $w_i(x,y) = \varphi_i(x,y)$

```
[vtr_Hz, val_Hz] = eig(A,B);
```



Useful MATLAB commands for visualization :

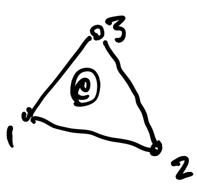
```
trisurf (TRI, X, Y, Z, C)
quiver (X, Y, U, V)
```



$$\nabla H_z = \hat{x}\frac{\partial H_z}{\partial x} + \hat{y}\frac{\partial H_z}{\partial y} + \underbrace{\hat{z}\frac{\partial H_z}{\partial z}}_{=0 \text{ since } H_z \text{ const. wrt } z}$$

$$= \left\{ H_z(x,y) = \sum_{j=1}^{N} h_j \varphi_j(x,y) \right\}$$

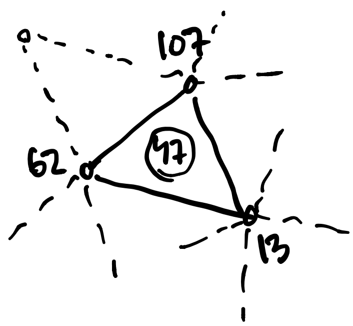
$$= \nabla\left(\sum_{j=1}^{N} h_j \varphi_j(x,y)\right) = \sum_{j=1}^{N} h_j \nabla\varphi_j(x,y)$$



$$\varphi_j^{(e)}(x,y) = a_j^{(e)} + b_j^{(e)} x + c_j^{(e)} y \quad \text{with } j=1,2,3$$

$$\nabla\varphi_j^{(e)}(x,y) = \hat{x}\,\frac{\partial\varphi_j^{(e)}(x,y)}{\partial x} + \hat{y}\,\frac{\partial\varphi_j^{(e)}(x,y)}{\partial y}$$

$$= \hat{x}\, b_j^{(e)} + \hat{y}\, c_j^{(e)}$$



$$H_z(x,y)\Big|_{e=47} = \sum_{j=1}^{N} h_j \varphi_j(x,y)\Big|_{e=47}$$

$$= h_{62}\varphi_{62}(x,y) + h_{13}\varphi_{13}(x,y) + h_{107}\varphi_{107}(x,y)\Big|_{e=47}$$

$$= h_{62}\varphi_1^{(47)}(x,y) + h_{13}\varphi_2^{(47)}(x,y) + h_{107}\varphi_3^{(47)}(x,y)$$

$$\text{el2no} = \begin{bmatrix} \vdots & \cdots & \vdots & 62 & \vdots & \cdots & \vdots \\ \vdots & \cdots & \vdots & 13 & \vdots & \cdots & \vdots \\ \vdots & \cdots & \vdots & 107 & \vdots & \cdots & \vdots \end{bmatrix}$$

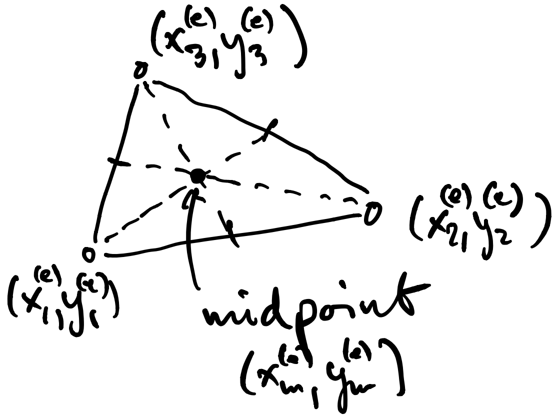
$\uparrow$ column #47

$$\nabla H_z(x,y)\Big|_{e=47} =$$

$$= h_{62}\underbrace{\nabla\varphi_1^{(47)}(x,y)}_{=\hat{x}b_1^{(47)} + \hat{y}c_1^{(47)}} + h_{13}\underbrace{\nabla\varphi_2^{(47)}(x,y)}_{=\hat{x}b_2^{(47)} + \hat{y}c_2^{(47)}} + h_{107}\underbrace{\nabla\varphi_3^{(47)}(x,y)}_{=\hat{x}b_3^{(47)} + \hat{y}c_3^{(47)}}$$

$$= \hat{x}\left(h_{62}b_1^{(47)} + h_{13}b_2^{(47)} + h_{107}b_3^{(47)}\right)$$

$$+ \hat{y}\left(h_{62}c_1^{(47)} + h_{13}c_2^{(47)} + h_{107}c_3^{(47)}\right)$$

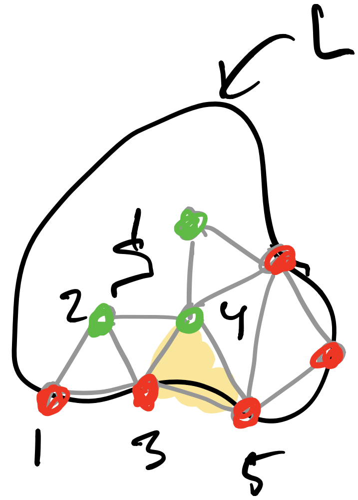


$$x_m^{(e)} = \frac{1}{3}\sum_{j=1}^{3} x_j^{(e)}$$

$$y_m^{(e)} = \frac{1}{3}\sum_{j=1}^{3} y_j^{(e)}$$

~ 11 ~

$$\begin{cases} -\nabla^2 E_z = k_t^2 E_z & \text{in } \Omega \\ E_z = 0 & \text{on } L \end{cases}$$



$$\mathbb{A}_{nat}\, \mathbf{e}_{nat} = k_t^2\, \mathbb{B}_{nat}\, \mathbf{e}_{nat}$$

only internal node coefficients

$$E_z(x,y) = \sum_{j=1}^{N} e_j \varphi_j(x,y)$$

$$\mathbf{e} = \begin{bmatrix} 0 \\ e_{nat,1} \\ 0 \\ \vdots \end{bmatrix}$$

all coefficients