

An image is a function  $\Omega$  to  $\mathbb{R}$ .  
A matrix is a discrete function.  
Let  $u$  be an image,  $f$  the observed image.  
The data fidelity/discrepancy function is

$$F(u) = \frac{1}{2} \|u - f\|_2^2 \quad (1)$$

The regularisation term is

$$\text{TGV}_\alpha^2(u) = \max \{ \langle u, \text{div}_h v \rangle_U \mid (v, w) \in V \times W, \text{div}_h w = v, \|w\|_\infty \leq \alpha_0, \|v\|_\infty \leq \alpha_1 \} \quad (2)$$

The total generalized variation (TGV) functional is defined as

$$\min_{u \in L^p(\Omega)} F(u) + \text{TGV}_\alpha^2(u) \quad (3)$$

$$(\partial_x^+ u)_{i,j} = \begin{cases} u_{i+1,j} - u_{i,j} & \text{for } 1 \leq i < N_1, \\ 0 & \text{for } i = N_1, \end{cases} \quad (4)$$

$$(\partial_y^+ u)_{i,j} = \begin{cases} u_{i,j+1} - u_{i,j} & \text{for } 1 \leq j < N_2, \\ 0 & \text{for } j = N_2, \end{cases} \quad (5)$$