Weighted-CEL0 sparse regularisation for molecule localisation in Super-Resolution microscopy with Poisson data

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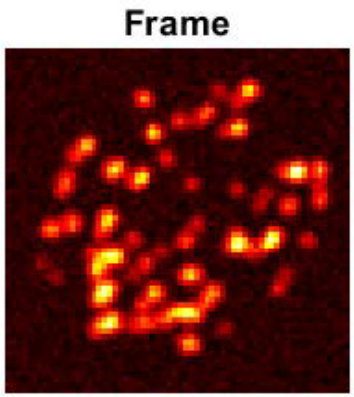
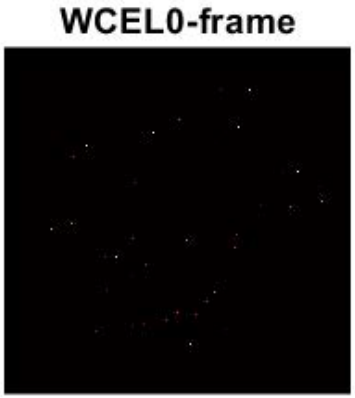
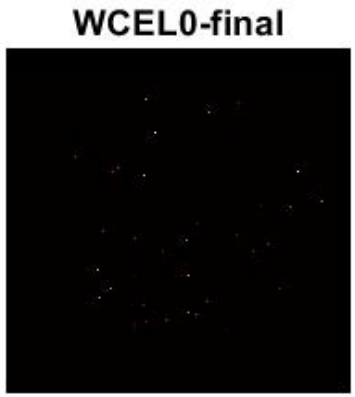
MORPHEME MORPHOLOGIE ET IMAGES

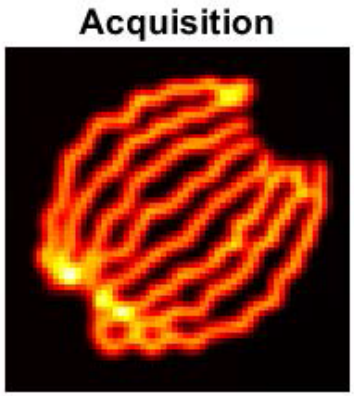
Single Molecule Localisation Microscopy

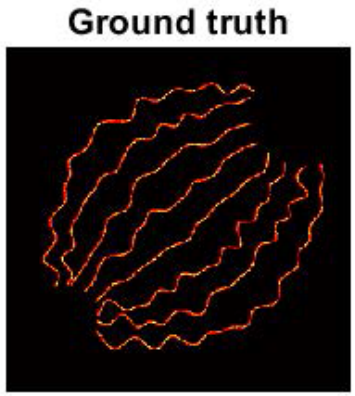
Light diffraction phenomena limits the spatial resolution.
SMLM idea: sequential activation/deactivation of molecules $\Longrightarrow$ **stack**.
Final reconstructed image=sum of singular frame reconstruction.







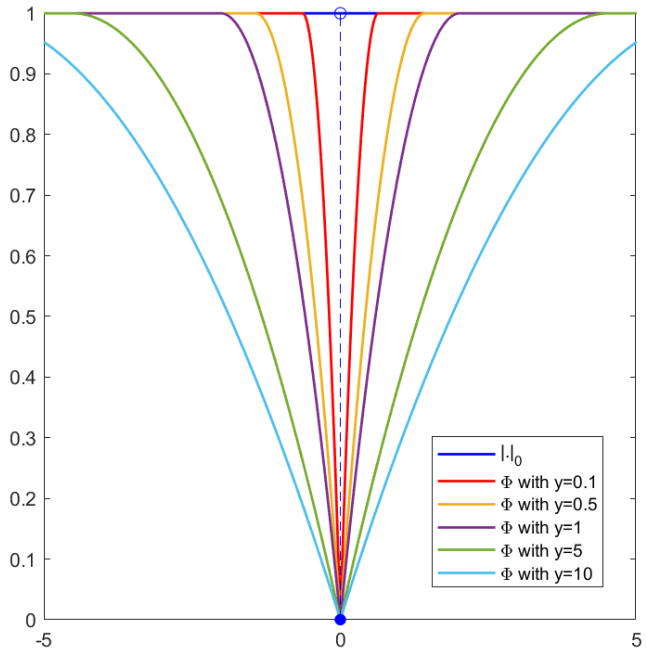




Weighted-CEL0 sparse regularisation

Sparsity-promoting weighted $\ell_2 - \ell_0$-type model, accounting for signal-dependent Poisson noise in SMLM data:

$$x^* \in \underset{x \in \mathbb{R}^{ML \times ML}}{\arg\min} \sum_{j=1}^{M^2} \frac{1}{2} \frac{\left((Ax)_j - y_j\right)^2}{y_j} + \lambda \|x\|_0$$



ℓ_0-norm $\Longrightarrow$ non-continuous, non-convex, NP-hard

Continuous non-convex relaxation of the ℓ_0-norm: weighted-CEL0 penalty

$$x^* \in \underset{x \in \mathbb{R}^{ML \times ML}}{\arg\min} \sum_{j=1}^{M^2} \frac{1}{2} \frac{\left((Ax)_j - y_j\right)^2}{y_j} + \Phi_{WCEL0}(x, \lambda, A, y)$$

Φ_{WCEL0} depends on the degradation matrix A and on the observed data y