COℓ_0RME

COvariance-based ℓ_0 super-Resolution Microscopy with intensity Estimation

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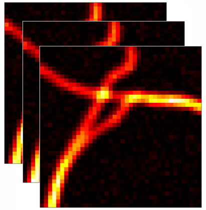
Design a sparsity-promoting mathematical model for Super-Resolution in Fluorescence Microscopy.

Features:

- Improved temporal/spatial resolution
- Harmless excitation levels
- Use of standard equipment
- Intensity estimation

Raw Data



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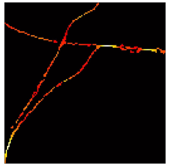

Acquire **short videos** with **high-density** of molecules per frame and use a reconstruction algorithm that codifies the assumption of the **temporal/spatial independence** between emitters and the **sparse distribution** of the fluorescent molecules

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Two steps:

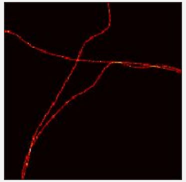
Support Estimation:

- Non-convex variational problem with a sparsity constraint formulated in the covariance domain
- Enforce Sparsity: Continuous Exact ℓ_0 Relaxation (CEL0)

$$\Phi_{\text{CEL0}}(\mathbf{r}_{\mathbf{x}};\lambda) = \sum_{i=1}^{L^2} \lambda - \frac{\|\mathbf{a}_i\|^2}{2}\left(|(\mathbf{r}_{\mathbf{x}})_i| - \frac{\sqrt{2\lambda}}{\|\mathbf{a}_i\|}\right) \mathbb{1}_{\{|(\mathbf{r}_{\mathbf{x}})_i| \leq \frac{\sqrt{2\lambda}}{\|\mathbf{a}_i\|}\}}$$

, where $\mathbf{a}_i = (\boldsymbol{\Psi} \odot \boldsymbol{\Psi})_i$

Intensity Estimation:



- Estimate intensity, only on the support, and background information
- Smoothness is promoted on intensity values

$\mathrm{CO}\ell_0\mathrm{RME}$: Good localization and reconstruction results!