Multimodal microscopy image alignment using spatial and shape information and a branch-and-bound algorithm (Supplementary materials)

1 Supplementary Algorithms

Algorithm 1: Neighboring cells matching

Neighbor_matching *(consensus_set)*
- $X, Y \leftarrow \text{cent}(consensus\_set)$; `// center of consensus set`
- $R_w \leftarrow \text{Wahba}(X, Y)$;
- $X^{(n)}, Y^{(n)} \leftarrow \text{cent\_neighbor}(consensus\_set)$;
- $Y_t^{(n)} \leftarrow Y^{(n)} \cdot R_w$;
- $R_n, \mathbf{P}_N \leftarrow \text{ICP}(X^{(n)}, Y_t^{(n)})$; `// ICP on neighbors`
- $R \leftarrow R_n R_w$;
- **return** R, $\mathbf{P}_N$; `// final transformation`

Algorithm 2: Iterative non-rigid transformation

Iterative_nonrigid_transform $\text{Img}_I, \text{Img}_J, tiles$
- $\text{Img}_I^{(ds)}, \text{Img}_J^{(ds)} \leftarrow \text{downsample}(\text{Img}_I, \text{Img}_J)$;
- $\text{out} \leftarrow \text{Img}_J^{(ds)}$;
- **for** i in number of iterations **do**
  - $\text{vec\_field} \in \mathbb{R}^{(M_0, M_1, M_2, 3)} \leftarrow 0$; $\text{vox\_weight} \leftarrow 0$; `// track the weight for each voxels`
  - **foreach** t *in tiles* **do**
    - $\text{img}_i, \text{img}_j \leftarrow \text{Img}_I^{(ds)}[t], \text{Img}_J^{(ds)}[t]$;
    - $\text{img}_j^s \leftarrow \text{phase\_correlation\_shift}(\text{img}_j, \text{offset})$;
    - **if** $NCC(\text{img}_i, \text{img}_j^s) > NCC(\text{img}_i, \text{img}_j)$ **then**
      - $\text{vec\_field}[t] += (NCC(\text{img}_i, \text{img}_j^s) - NCC(\text{img}_i, \text{img}_j)) * \text{offset}$;
      - $\text{vox\_weight}[t] += NCC(\text{img}_i, \text{img}_j^s) - NCC(\text{img}_i, \text{img}_j)$;
    - **end**
  - **end**
  - $\text{vec\_field} = \text{vec\_field}/(\text{vox\_weight} + 1.0e^{-5})$; `// prevent dividing by zero`
  - $\text{out} \leftarrow \text{warp}(\text{out}, \text{gaussian\_blur}(\text{vec\_field}))$;
- **end**
- **return** $\text{Img}_J^t \leftarrow \text{upsample}(\text{out})$