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1:  $g \sim \text{HalfNormal}(50)$  ▷ camera gain
2:  $\sigma^{xy} \sim \text{Exponential}(1)$  ▷ standard deviation of on-target spot position (pixels)
3:  $\pi \sim \text{Beta}(1/2, 1/2)$  ▷ mean specific binding probability
4:  $\lambda \sim \text{Exponential}(1)$  ▷ non-specific binding density
5: for all AOI[ $N + N_c$ ] do
6:    $\mu^b \sim \text{HalfNormal}(1000)$  ▷ mean background intensity
7:    $\sigma^b \sim \text{HalfNormal}(100)$  ▷ standard deviation of background intensity
8:   for all frame[ $F$ ] do
9:      $b \sim \text{Gamma}(\mu^b, \sigma^b)$  ▷ background intensity
10:     $z \sim \begin{cases} \text{Bernoulli}(\pi) & \text{on-target AOI} \\ \text{Bernoulli}(0) & \text{control off-target AOI} \end{cases}$  ▷ target-specific spot presence
11:     $\theta \sim \begin{cases} \text{Categorical}([1, 0, \dots, 0]) & z = 0 \\ \text{Categorical}([0, \frac{1}{K}, \dots, \frac{1}{K}]) & z = 1 \end{cases}$  ▷ target-specific spot index
12:    for all spot[ $K$ ] do
13:       $m_{\text{spot}(k)} \sim \begin{cases} \text{Bernoulli}(1) & \theta = k \\ \text{Bernoulli}\left(\frac{\sum_{l=1}^K l \cdot \text{TruncPoisson}(l; \lambda, K)}{K}\right) & \theta = 0 \\ \text{Bernoulli}\left(\frac{\sum_{l=1}^{K-1} l \cdot \text{TruncPoisson}(l; \lambda, K-1)}{K-1}\right) & \text{otherwise} \end{cases}$  ▷ spot presence
14:       $h \sim \text{HalfNormal}(10000)$  ▷ spot intensity
15:       $w \sim \text{Uniform}(0.75, 2.25)$  ▷ spot width
16:       $x_{\text{spot}(k)} \sim \begin{cases} \text{AffineBeta}\left(0, \sigma^{xy}, -\frac{P+1}{2}, \frac{P+1}{2}\right) & \theta = k \\ \text{Uniform}\left(-\frac{P+1}{2}, \frac{P+1}{2}\right) & \theta \neq k \end{cases}$  ▷ x-axis center
17:       $y_{\text{spot}(k)} \sim \begin{cases} \text{AffineBeta}\left(0, \sigma^{xy}, -\frac{P+1}{2}, \frac{P+1}{2}\right) & \theta = k \\ \text{Uniform}\left(-\frac{P+1}{2}, \frac{P+1}{2}\right) & \theta \neq k \end{cases}$  ▷ y-axis center
18:      for all pixelX[ $P$ ]  $\times$  pixelY[ $P$ ] do
19:         $\mu_{\text{pixelX}(i), \text{pixelY}(j)}^S = \frac{m \cdot h}{2\pi w^2} \exp\left(-\frac{(i-x-x^{\text{target}})^2 + (j-y-y^{\text{target}})^2}{2w^2}\right)$  ▷ 2-D Gaussian spot
20:      for all pixelX[ $P$ ]  $\times$  pixelY[ $P$ ] do
21:         $\delta \sim \text{Empirical}(\delta_{\text{samples}}, \delta_{\text{weights}})$  ▷ offset signal
22:         $\mu^I = b + \sum_{\text{spot}} \mu^S$  ▷ mean pixel intensity w/o offset
23:         $I \sim \text{Gamma}(\mu^I, \sqrt{\mu^I \cdot g})$  ▷ pixel intensity w/o offset
24:         $D = \delta + I$  ▷ observed pixel intensity

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