A Formulas

2D Haar wavelets. The 2D Haar wavelet scaling ($\mathbf{\Phi}$) and mother ($\mathbf{\Psi}$) functions are calculated from the 1D functions as:

$$
\begin{aligned}
\Phi(s_1,s_2) &= \phi(s_1)\phi(s_2) = \begin{cases} 1 & \text{if } 0 \le s_1 < 1, 0 \le s_2 < 1 \\ 0 & \text{otherwise} \end{cases} \\
\Psi^H(s_1,s_2) &= \phi(s_1)\psi(s_2) = \begin{cases} 1 & \text{if } 0 \le s_1 < 1, \quad 0 \le s_2 < \frac{1}{2} \\ -1 & \text{if } 0 \le s_1 < 1, \quad \frac{1}{2} \le s_2 < 1 \\ 0 & \text{otherwise} \end{cases} \\
\Psi^V(s_1,s_2) &= \psi(s_1)\phi(s_2) = \begin{cases} 1 & \text{if } 0 \le s_1 < \frac{1}{2}, \quad 0 \le s_2 < 1 \\ -1 & \text{if } \frac{1}{2} \le s_1 < 1, \quad 0 \le s_2 < 1 \\ 0 & \text{otherwise} \end{cases} \\
\Psi^D(s_1,s_2) &= \psi(s_1)\psi(s_2) = \begin{cases} 1 & \text{if } 0 \le s_1 < \frac{1}{2}, \quad 0 \le s_2 < \frac{1}{2} \\ 1 & \text{if } \frac{1}{2} \le s_1 < 1, \quad \frac{1}{2} \le s_2 < 1 \\ -1 & \text{if } 0 \le s_1 < \frac{1}{2}, \quad \frac{1}{2} \le s_2 < 1 \\ -1 & \text{if } \frac{1}{2} \le s_1 < 1, \quad 0 \le s_2 < \frac{1}{2} \\ 0 & \text{otherwise.} \end{cases}
\end{aligned}
$$

Induced prior probability for simultaneous change at two pixels. The induced joint probability of no change for two pixels is derived based on the shared wavelet components of the two pixels:

$$
\begin{aligned}
P(r_{it} > L, r_{i't} > L) &= \textstyle\prod_{j \in A_i, j' \in A_{i'}} P(\tilde{r}_{jt} > L, \tilde{r}_{j't} > L) \\
&= \textstyle\prod_{j \in A_i, j' \in A_{i'}} P(\tilde{r}_{jt} > L | \tilde{r}_{j't} > L) P(\tilde{r}_{j't} > L) \\
&= \textstyle\prod_{j = j' \in A_i \cap A_{i'}} P(\tilde{r}_{jt} > L | \tilde{r}_{j't} > L) P(\tilde{r}_{j't} > L) \\
&* \textstyle\prod_{j \in A_i \cap A_i'^c, j' \in A_i' \cap A_i^c} P(\tilde{r}_{jt} > L | \tilde{r}_{j't} > L) P(\tilde{r}_{j't} > L) \\
&= \textstyle\prod_{j = j' \in A_i \cap A_{i'}} 1 * P(\tilde{r}_{j't} > L) \prod_{j \in A_i \cap A_i'^c, j' \in A_i' \cap A_i^c} P(\tilde{r}_{jt} > L) P(\tilde{r}_{j't} > L) \\
&= p_0^{|A_i \cap A_i'|} p_0^{|A_i / A_i'|} p_0^{|A_i' / A_i|} \\
&= p_0^{|A_i \cap A_i'| + |A_i / A_i'| + |A_i' / A_i|} \\
&= p_0^{|A_i| + |A_i'| - |A_i \cap A_i'|}
\end{aligned}
$$

B Sensitivity

MR roboBayes was run on a realization of the simulation in Section 5 for different input settings. The resulting detection precision, recall, F1 score, and latency are shown in Table 1. Choosing an appropriate Λ is important for achieving good metrics; a scaled value tends to work better than an estimation. MR roboBayes applied to a subset and requiring change in at least one component has good recall for all input scenarios. Recall is somewhat sensitive to the degree of freedom ν choice. Precision is sensitive to the search length and, to a lesser degree, the degrees of freedom and the Λ scale. MR roboBayes applied to a subset and requiring change in at least two components is quite robust to the inputs explored here. In general, latency is more sensitive to the chosen method than to the input parameters.

Table 1: Sensitivity of MR roboBayes to parameters.

Method	L	V scale	ν_0	Λ_0 scale	Precision	Recall	F1	Latency
MR roboBayes count1 subset	30	1	$\hat{nu}$	0	0.08	1.00	0.15	4.00
MR roboBayes count1 subset	15	1	$\hat{nu}$	0	0.45	1.00	0.62	4.00
MR roboBayes count1 subset	50	1	$\hat{nu}$	0	0.06	1.00	0.11	4.00
MR roboBayes count1 subset	30	2	$\hat{nu}$	0	1.00	1.00	1.00	4.00
MR roboBayes count1 subset	30	1	4	0	1.00	0.80	0.89	5.25
MR roboBayes count1 subset	30	1	10	0	1.00	0.80	0.89	4.25
MR roboBayes count1 subset	30	1	$\hat{nu}$	1	0.26	1.00	0.42	4.00
MR roboBayes count1 subset	30	1	$\hat{nu}$	0.1	1.00	1.00	1.00	4.00
MR roboBayes count2 subset	30	1	$\hat{nu}$	0	1.00	1.00	1.00	4.00
MR roboBayes count2 subset	15	1	$\hat{nu}$	0	1.00	1.00	1.00	4.00
MR roboBayes count2 subset	50	1	$\hat{nu}$	0	0.23	1.00	0.37	4.00
MR roboBayes count2 subset	30	2	$\hat{nu}$	0	0.83	1.00	0.91	5.00
MR roboBayes count2 subset	30	1	4	0	1.00	0.60	0.75	4.00
MR roboBayes count2 subset	30	1	10	0	0.57	0.80	0.67	4.25
MR roboBayes count2 subset	30	1	$\hat{nu}$	1	0.11	1.00	0.20	4.00
MR roboBayes count2 subset	30	1	$\hat{nu}$	0.1	1.00	1.00	1.00	4.00