4.2.4. Calculation of P_d

We note that $P_d = P_{d|W}P_W + P_{d|W^c}P_{W^c}$. To calculate $P_{d|W}$, we first consider $P_{d|H_s}$. We see

$$\begin{aligned} P(d|H_s) &= P(\min_{i=1,..,N} d_i \leq \tau | H_s) \\ &= 1 - \prod_{i=1}^{N} P(d_i \geq \tau + 1 | H_s) \\ &= 1 - G_1(\tau + 1 - d_{I,s}) \prod_{m=1,\, m\neq s}^{N} G_0(\tau + 1 - d_m). \end{aligned}$$

Averaging as in (14), we now derive $P_{d|W}$ as follows:

$$\begin{aligned} P_{d|W} &= 1 - \sum_{v=0}^{W} \frac{C_W^v}{2^W} \sum_{j=0}^{\tau} G_1(j-v) G_0^{-1}(j+1-v) \\ &\quad \times \prod_{u=0}^{W} G_0^{DC_W^u}(j+1-u). \end{aligned} \tag{21}$$

Last, we conclude from (1) and $P_{c|W^c} = 0$ and $P_{m|W^c} = P_f$, $P_{d|W^c} = P_{m|W^c} = P_f$. Alternatively, using (1), P_d can be derived from the formulas for P_c and P_m given above.

5. DYNAMIC DATABASE CONFIGURATION

When the system is initialized, a maximum fingerprint length L_{max} is defined. Using maximum values of N and p and a minimum value of P_W envisioned for the target application, one uses the probability formula derived in sec. 4 and a series of values for L, I, τ, W to find the smallest value of $L = L_{max}$ for which one obtains the target values for P_f, P_c,P_m, and P_d. During operation, one similarly uses the current values of N, p, P_W to determine the actual values of $L_{actual}, I_{actual}, \tau_{actual}, W_{actual}$ such that the resulting values of P_f, P_c, P_m, and P_d best match the target values for the application. For each reference multimedia object, a fingerprint of length L_{max} is extracted. The L_{max} bits are divided in two S_1 and S_2 containing L_{actual} and $L_{Max} - L_{actual}$ bits, respectively. For any database query, only the L_{actual} bits in S_1 are considered. The sets S_1 and S_2 are updated whenever one of the input parameters N, p, P_W or one of the target probabilities changes.

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