Computational Complexity of Ida's algorithm

The computational complexity of the matching algorithm is given by:

$$O(\tilde{\psi}) = \left(\frac{1-r}{2}\right)^2 e^4$$

Thus, the computational complexity of Ida's algorithm with one domain-size (e) is computed as follows:

$$O_e(\text{Ida's Algorithm}) = \left(\frac{1-r}{2}\right)^2 e^4\kappa + O\left(\overline{L}\eta_e\right) = \left(\frac{1-r}{2}\right)^2 e^4\kappa - \overline{L}\log_r\left(\frac{e}{2}\right)$$

where $\overline{L} = E[L]$ is the expectation of the number of pixels of the alpha mask foreground (L). Finally, the total computational complexity is given by:

$$\begin{aligned} O(\text{Ida's Algorithm}) &= \sum_{i=0}^{\log_2\left(\frac{e_{\max}}{e_{\min}}\right)} \left(\frac{1-r}{2}\right)^2 \left(\frac{e_{\max}}{2^i}\right)^4 \kappa - \overline{L}\log_r\left(\frac{e_{\max}}{2^{i+1}}\right) \\ &\approx \frac{4\kappa(1-r)^2}{15} e_{\max}^4 - \overline{L}\log_2\left(\frac{e_{\max}}{e_{\min}}\right)\log_r\left(\frac{e_{\min}e_{\max}}{8}\right) \end{aligned}$$

According to the above equation, the computational complexity of Ida's algorithm is of order four with respect to $e_{\max}$, i.e. $O(e_{\max}^4)$. Therefore, growing the domain size rapidly increases the computational cost of the algorithm.