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Randomly Removing  $g$  Handles at Once

It was shown in [Indyk and Sidiropoulos 07] that any orientable graph of genus  $g$  can be probabilistically embedded into a graph of genus  $g - 1$  with constant distortion. In particular, such graphs embed into a distribution over planar graphs with distortion  $\exp(O(g))$ . By removing all  $g$  handles at once, we present a probabilistic embedding with distortion  $\text{poly}(g)$ , which also works in the non-orientable case. Our result is obtained by showing that the minimum-cut graph [Erickson and Harper 2004] has low dilation, and then randomly cutting this graph out of the surface using the Peeling Lemma of [Lee and Sidiropoulos 08].