

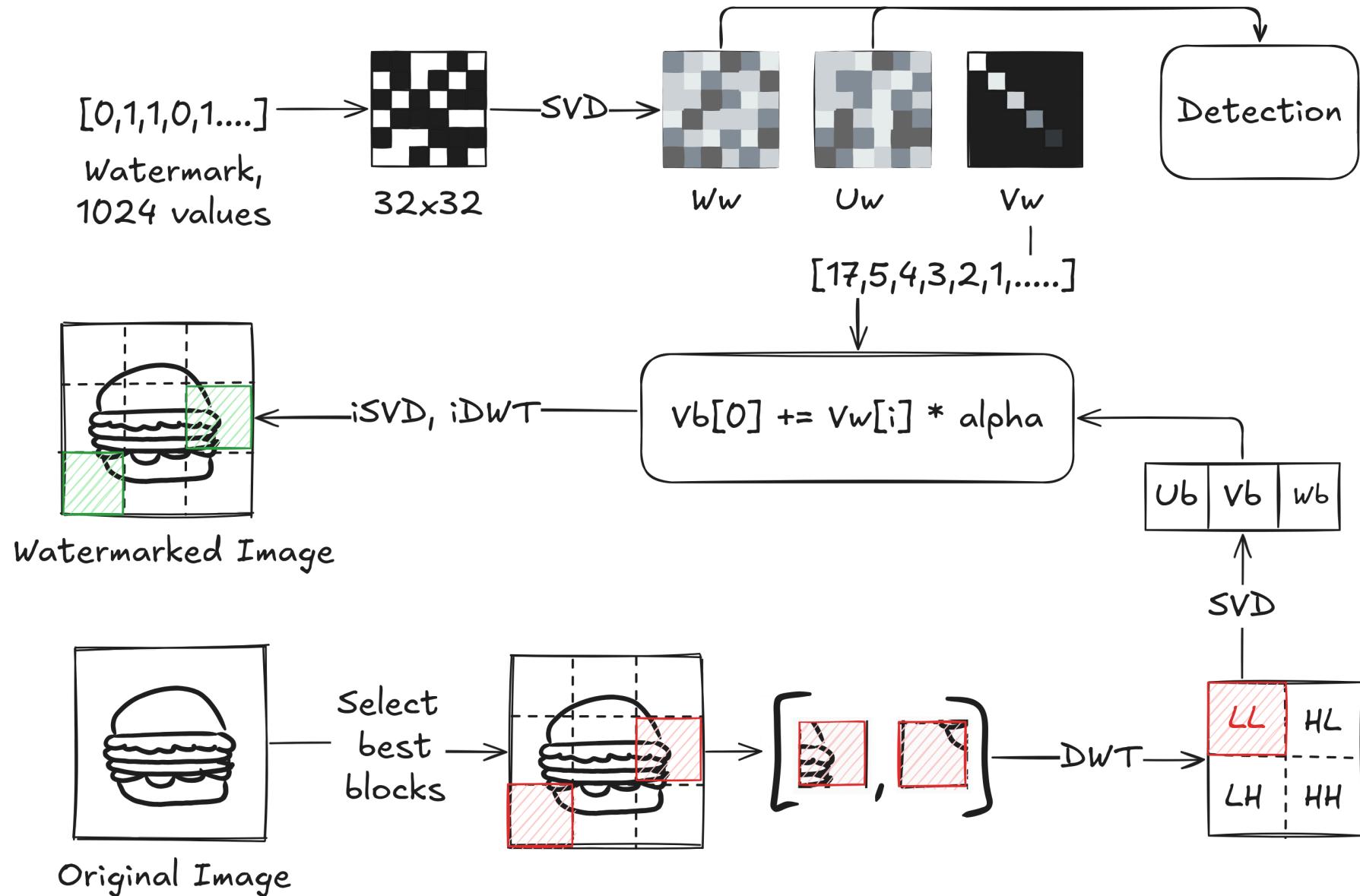
CrispyMcMark

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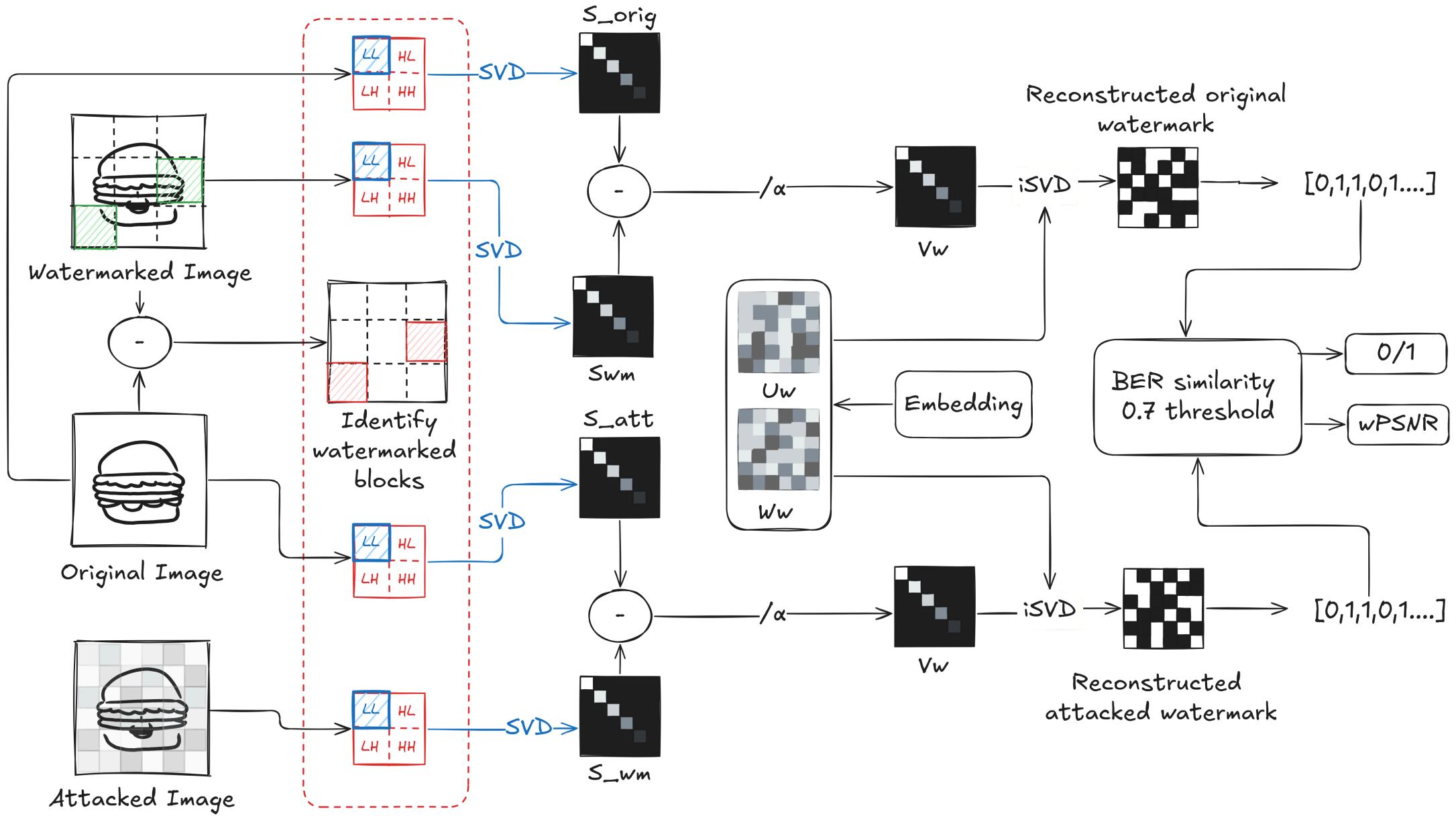
Embedding

- reshape watermark to 32x32 and take $U_w, V_w, W_w = SVD(\text{watermark})$
- U_w, W_w hardcoded in the detection, V_w are the singular values
- choose x square blocks
- forall $i < x$:
 - take LL_b of the DWT of $\text{blocks}[i]$
 - compute the singular values V_b of its LL
 - embed $V[i]$ into the first singular value($V_b[0]$)
 - inverse the first two steps to reconstruct the block, and put it back into the image



Detection

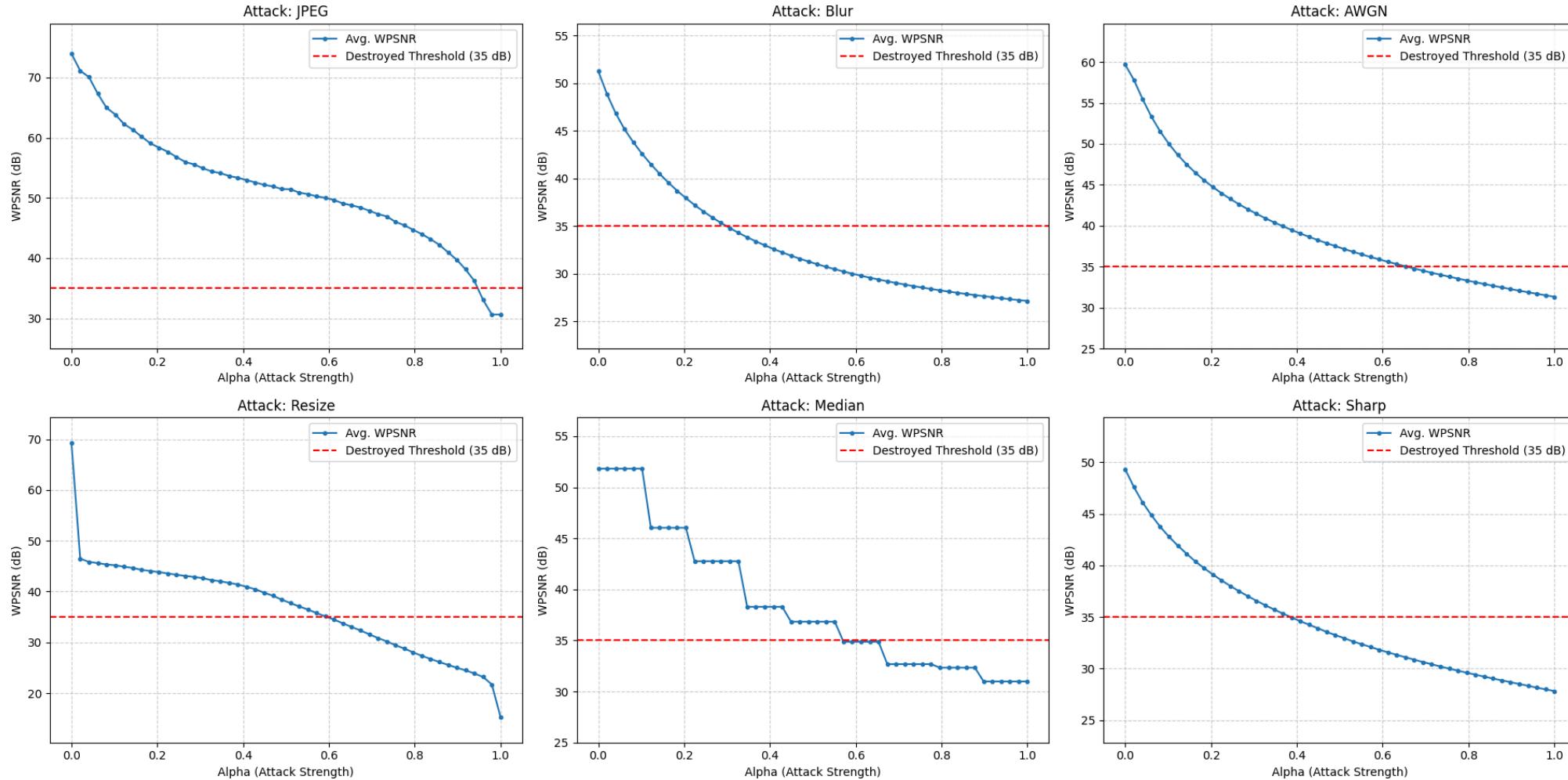
- use watermarked - original image to find x watermarked blocks
- attacked watermark = difference between singular values of attacked blocks and original blocks
- original watermark = difference between singular values of watermarked blocks and original blocks
- detection compares the two extracted watermarks using threshold



Attack Strategy

- binary search to find optimal attack strength
- attack functions tweaked to accept parameter $0 \leq \beta \leq 1$
- use of masks to attack different areas of the image
- parallelization to improve execution speed

Attack Strategy - binary search



Attack Strategy - masks

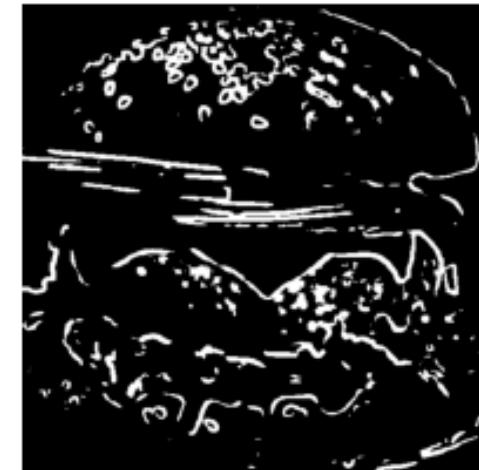
original_img



edges_mask



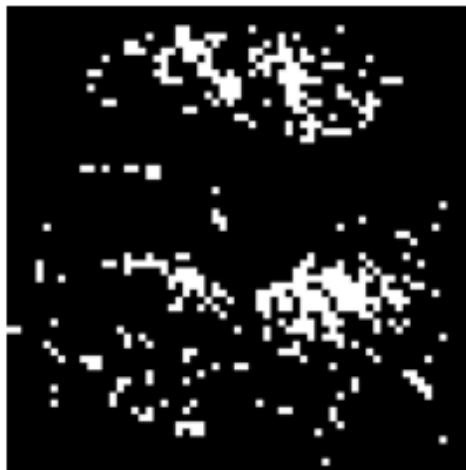
noisy_mask



attack_mask



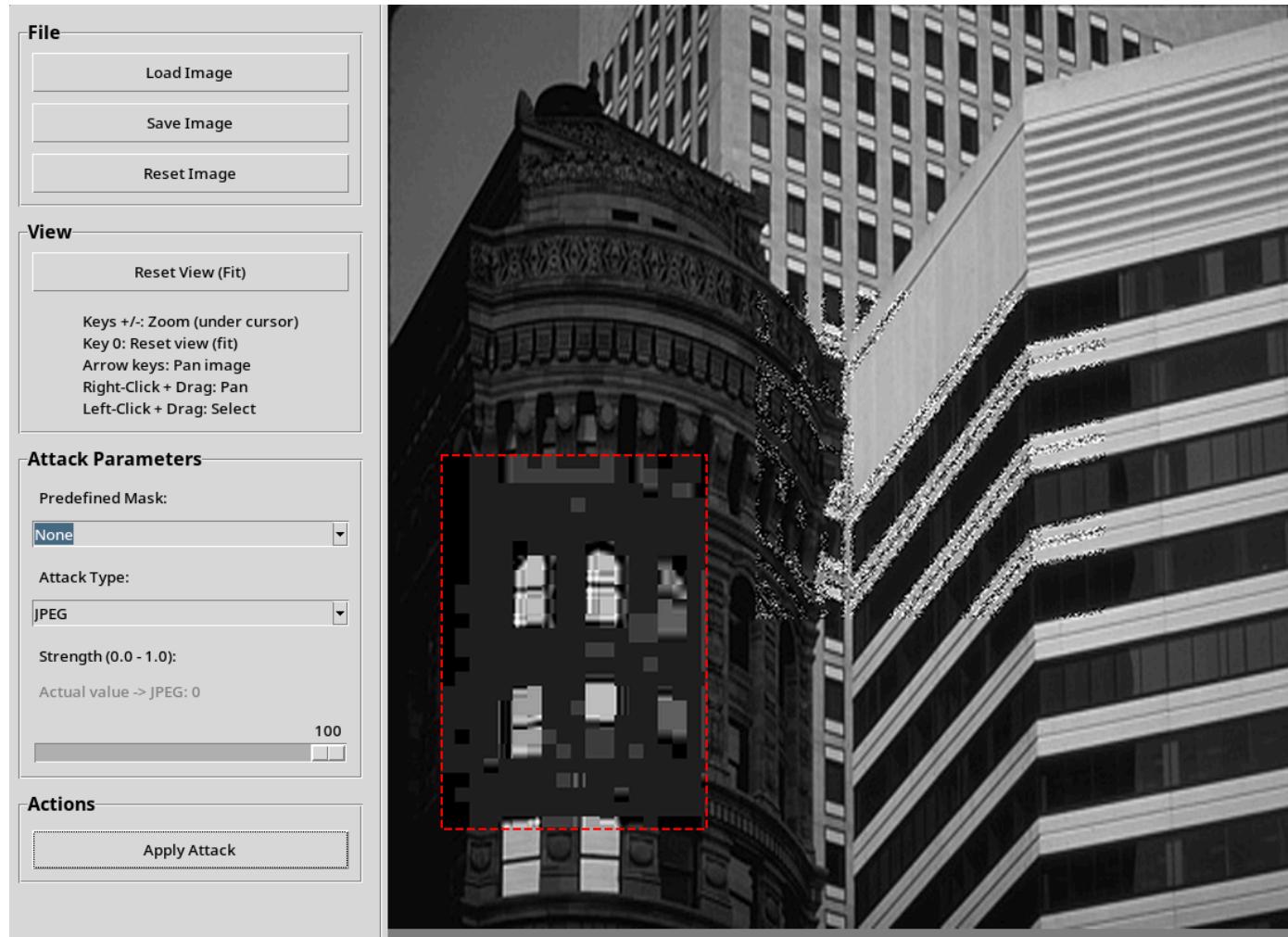
frequency_mask



saliency_mask



Attack Strategy - GUI tool



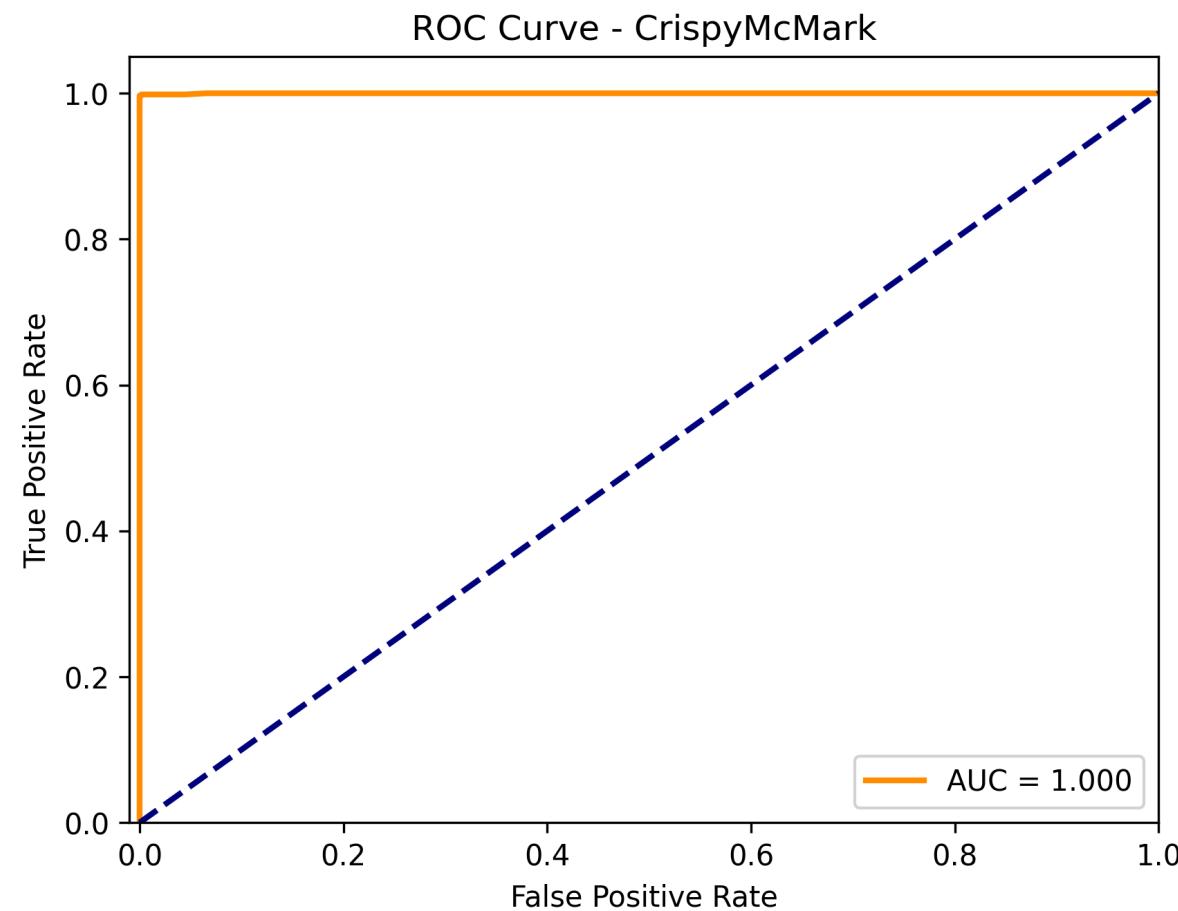
Possible Improvements

- Add redundancy based on singular value importance
- Improve the invisibility of attack squares, either by block choice or embedding strength
- explore different embedding techniques on each block

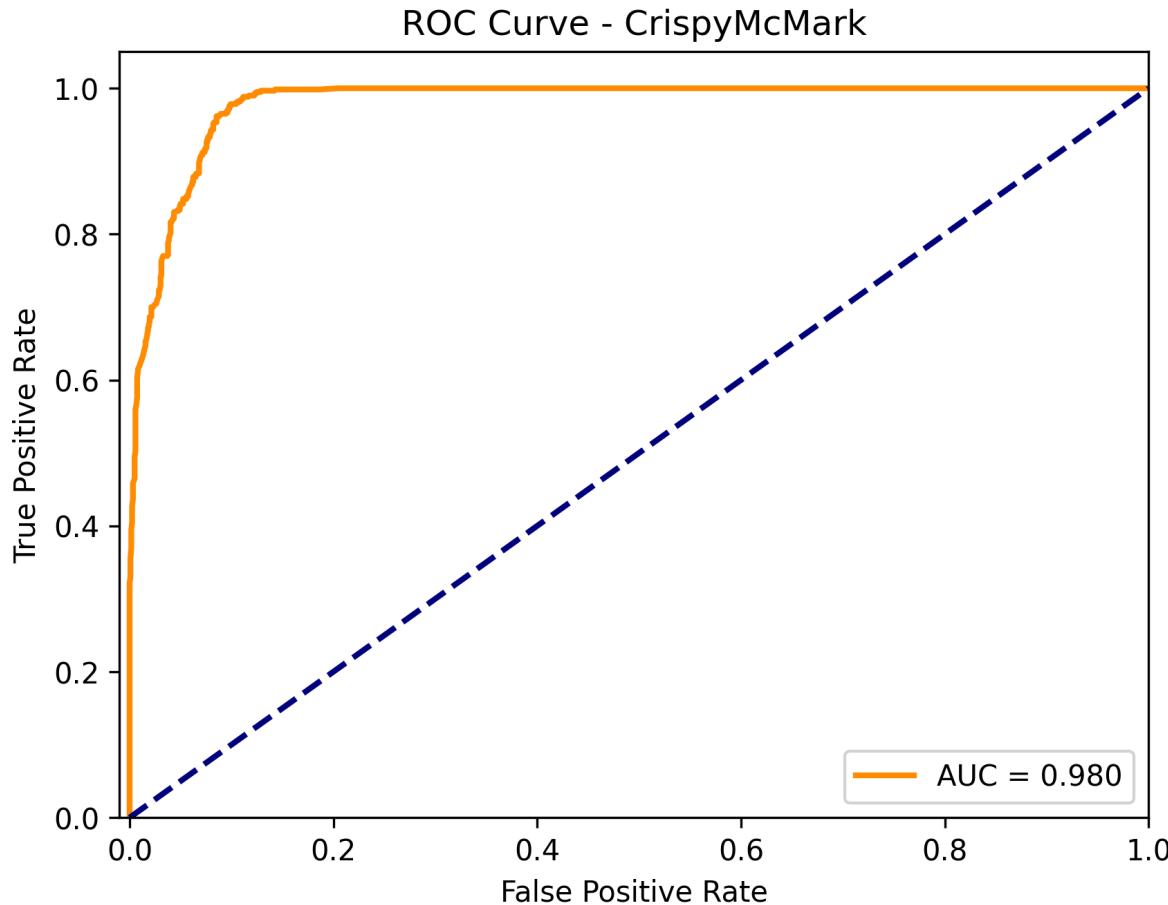
Implementation challenges

- Embedding quality performed better on images with high entropy zones
- On low entropy images embedding was more visible
- Not enough time to refine the design and try different techniques
- Multiplicative embedding was harder to tweak
- Understanding how the algorithm performed/finding bugs based on the ROC function.

ROC1: Original

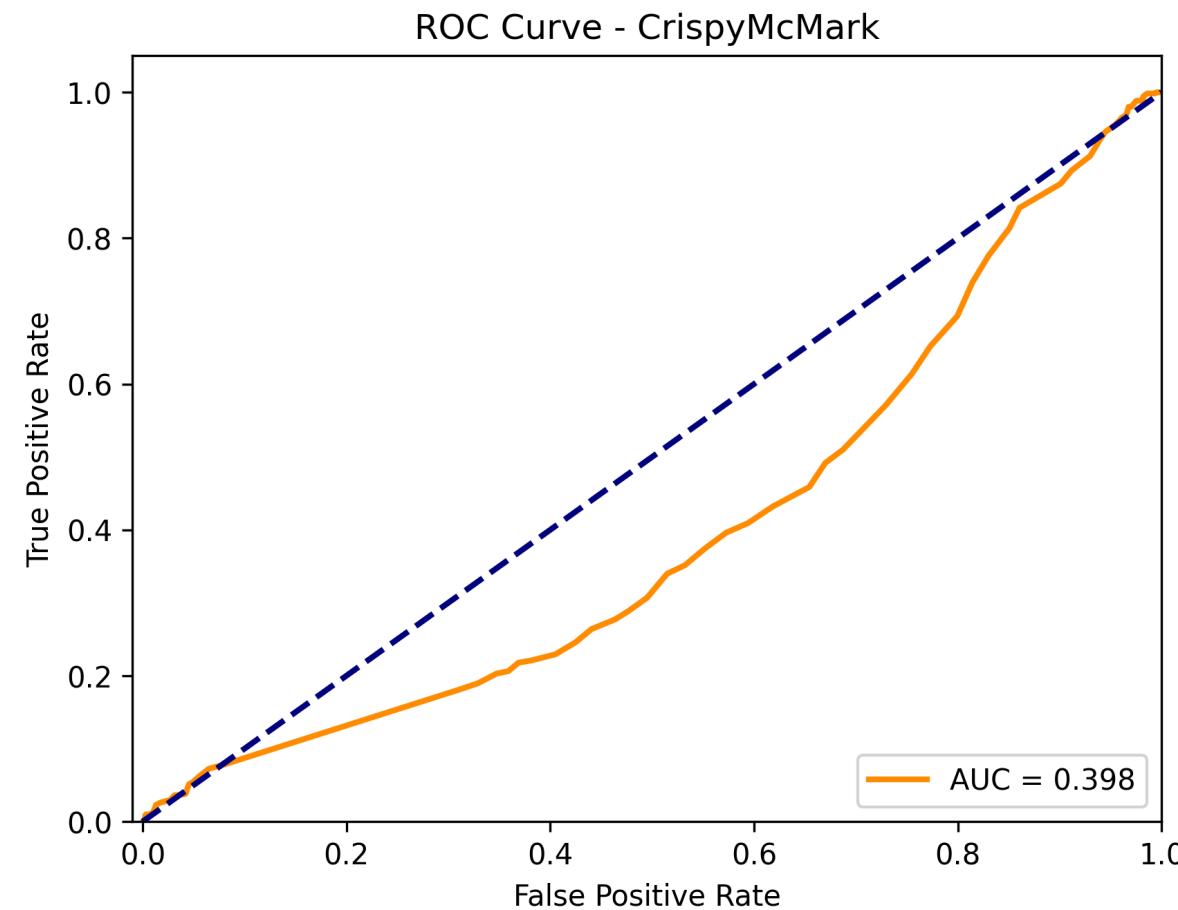


ROC2



ROC1 + label 0 for original(attacked) images + label 0 for destroyed

Effects of hardcoding the watermark



How we reached the final implementation

- found papers about DWT-SVD
- began with DWT-SVD on the whole image
- then transitioned to blocks, embedding two singular values for each block
- switched to embedding one singular value per block

Questions?

