Image Convolution Application based on OpenACC

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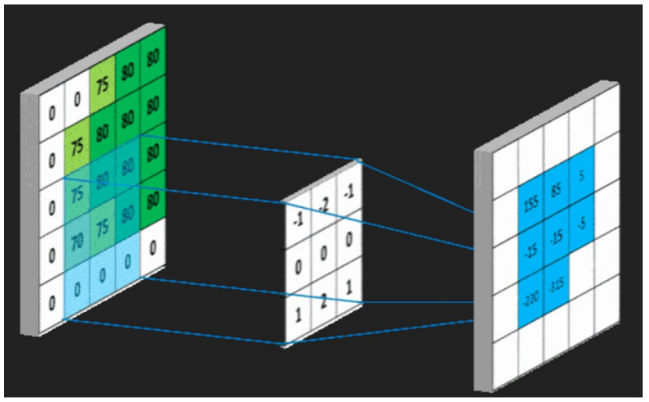
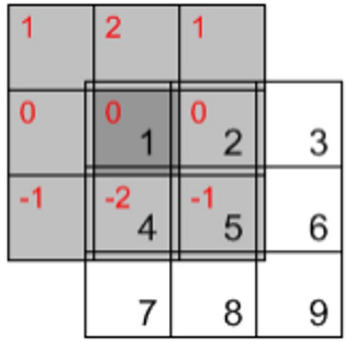
Basic Formula

$$g(x,y) = \omega * f(x,y) = \sum_{s=-a}^{a} \sum_{t=-b}^{b} \omega(s,t) f(x-s, y-t),$$

g(x,y) is the filtered image, f(x,y) is the original image,
w is the filter kernel. Every element of the filter kernel
is considered by -a <= s <= a and -b<= s <= b
(https://en.wikipedia.org/wiki/Kernel_(image_processing))



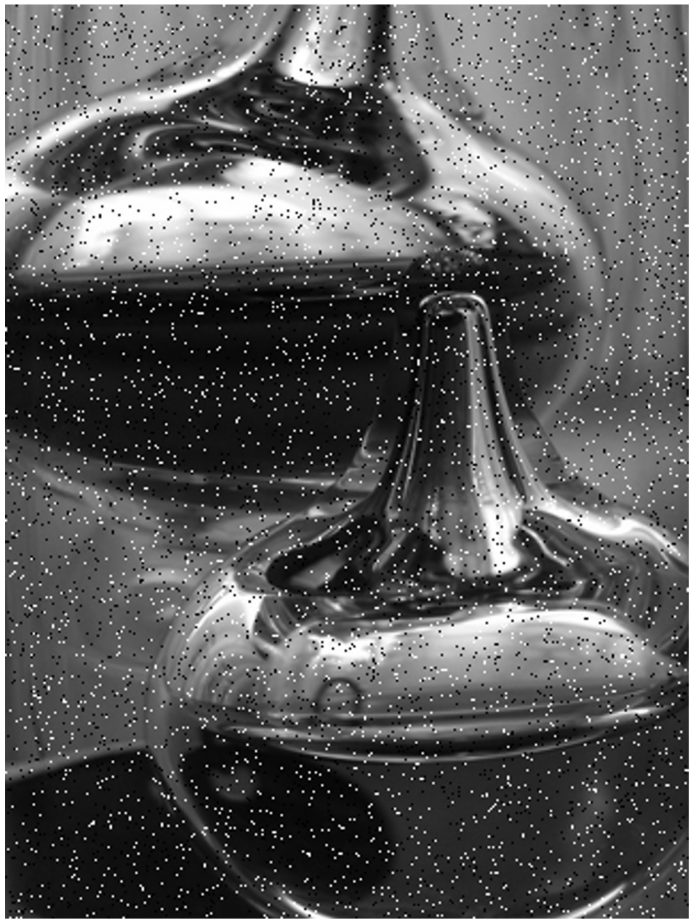


- No data dependency/hazard
- Easy to parallel
- Clearer results for debugging

$$\begin{aligned} y[0,0] = {} & x[-1,-1]\cdot h[1,1] + x[0,-1]\cdot h[0,1] + x[1,-1]\cdot h[-1,1] \\ & + x[-1,0]\cdot h[1,0] + x[0,0]\cdot h[0,0] + x[1,0]\cdot h[-1,0] \\ & + x[-1,1]\cdot h[1,-1] + x[0,1]\cdot h[0,-1] + x[1,1]\cdot h[-1,-1] \\ = {} & 0\cdot 1 + 0\cdot 2 + 0\cdot 1 + 0\cdot 0 + 1\cdot 0 + 2\cdot 0 + 0\cdot (-1) + 4\cdot (-2) + 5\cdot (-1) = -13 \end{aligned}$$

Things we want to cover

- Sharpening
  - Applied to image reinforcement, fault detection and so on
  - Preprocess for training data
- Smoothing
  - Smoothing is often used to reduce noise within an image or to produce an image with lower resolution
  - Reduce salt-pepper noise (Median filtering)
- Inter-frame Difference
  - Motion detection with fixed background
  - Better performance on real-time video with higher processing speed.



** Do be careful with edge conditions

What’s going to be finished

- Components for each method
- Benchmark on time consuming with & without acceleration
- Maybe a moving object detection using inter-frame difference method...