

## INTRODUCTION

- Image quality can be severely degraded by surgical smoke
  - Introduces errors for the image processing algorithms (used in image guided surgery)
  - Reduces the visibility of the observed organs and tissues.
- Smoke removal methods
  - Mechanical solutions
  - Image processing based approaches [1]

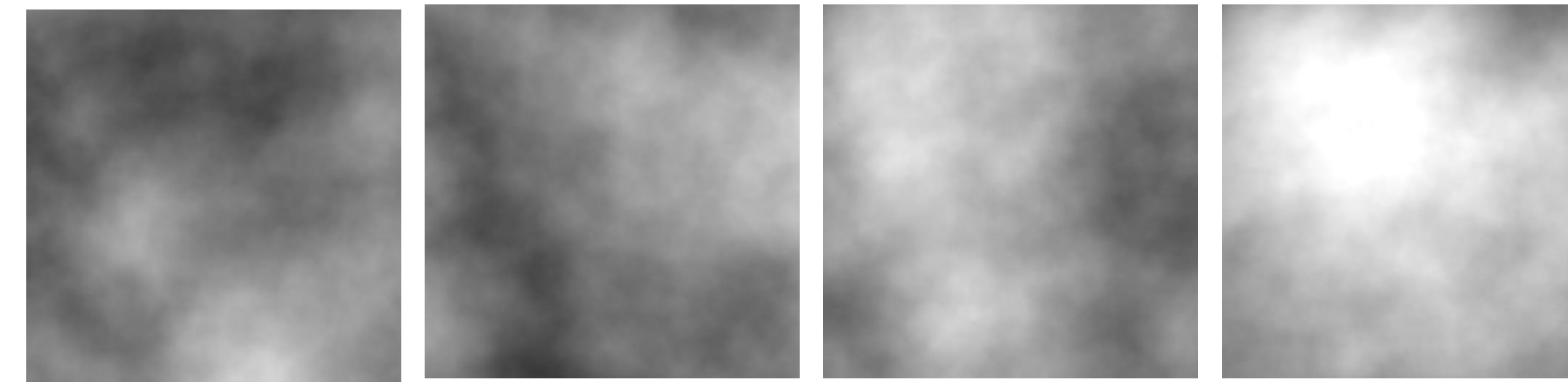
**Aim:**  
Automatic and real-time image processing based smoke removal method.

## CONTRIBUTIONS

- First known application of CNN based surgical smoke removal.
- Employ synthetic smoke to generate training dataset
- Processing speed reaches 20 fps for 512x512 color videos on a single NVIDIA Titan X GPU.

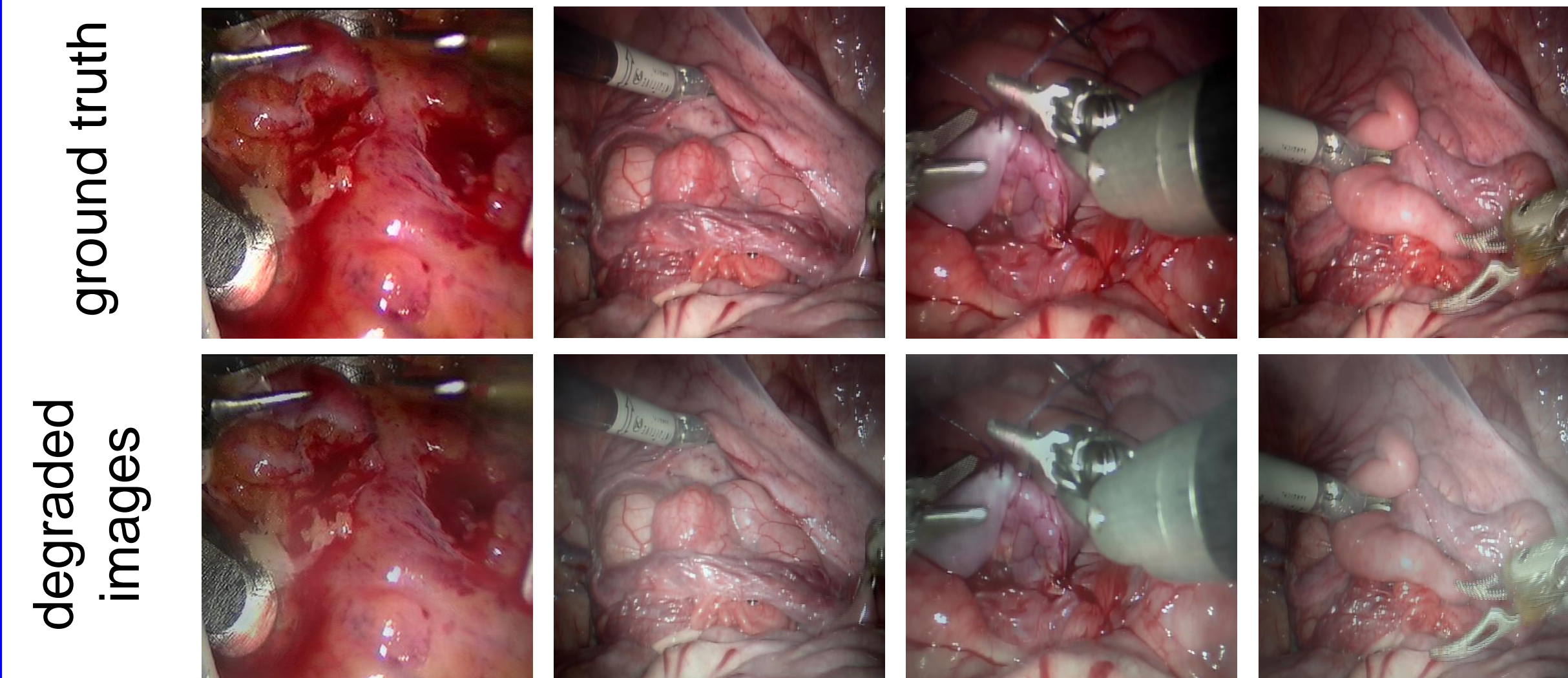
## METHOD

- Generate smoke by Perlin noise

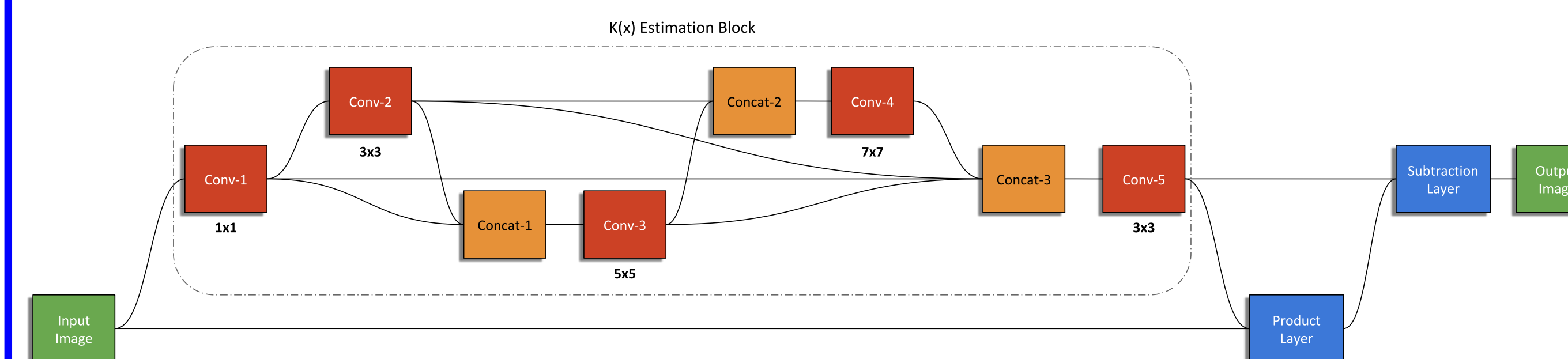


- Embed the generated smoke to smoke free images

$$I_e^c(x) = I_g^c(x) + 0.8(I_s^c(x) - 1 / N \sum_{i=1}^N I_s^c(i))$$



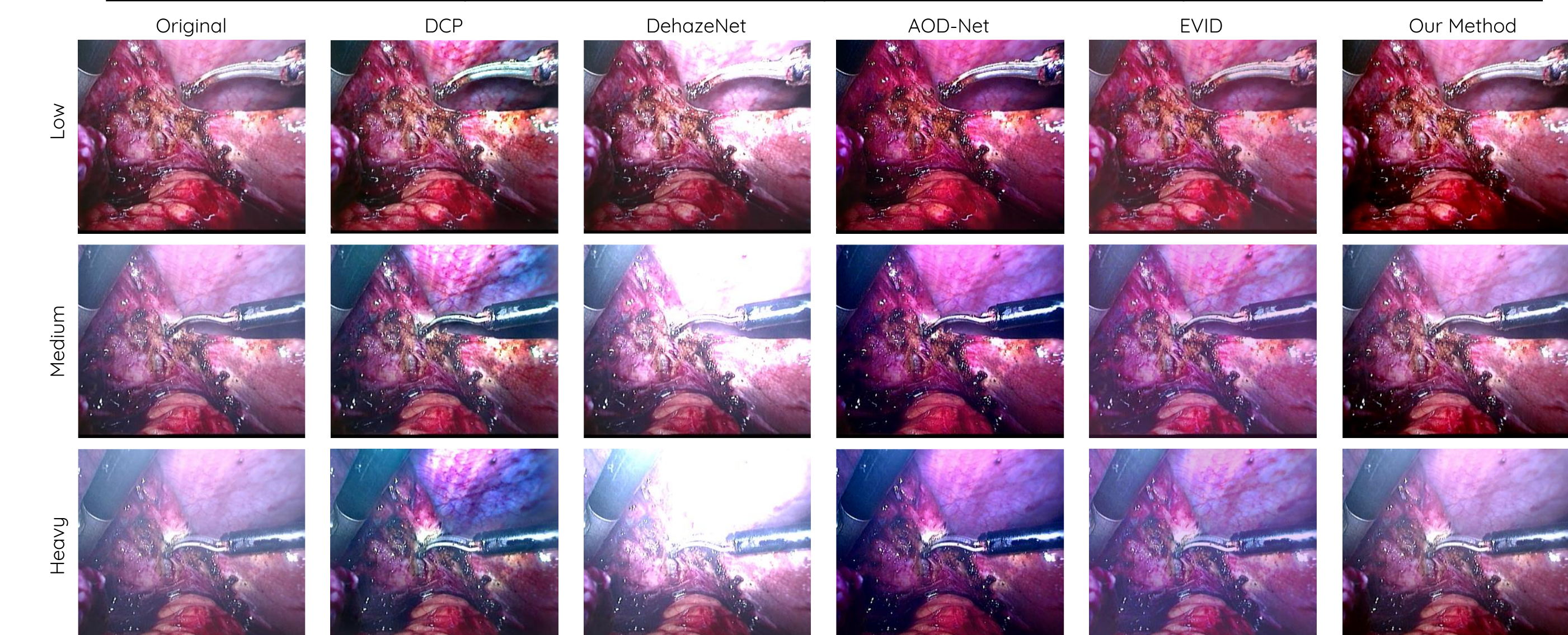
- Fine-tune AOD-Net [2]



## RESULTS

- Performance evaluation on synthetic and real smoke images

Methods	MSE	PSNR	MAD
DCP	1.51±0.89	18.59±3.28	116.48±14.76
DehazeNet	3.09±1.77	15.36±285	125.07±8.82
AOD-Net	1.42±0.40	18.36±2.11	118.52±7.26
EVID	1.07±0.46	19.45±1.66	117.20±7.68
Our	<b>1.00±0.36</b>	<b>19.72±1.57</b>	<b>97.85±8.66</b>



## DISCUSSION

- Our proposed method can preserve the color fidelity while eliminating apparent smoke.
- All the methods fail in heterogeneous smoke case.
- Further studies could focus on utilizing a perceptually relevant loss function and including temporal consistency into the network.

## REFERENCES

- [1] Luo, Xiongbiao, et al. "Vision-based surgical field defogging." *IEEE transactions on medical imaging* 36.10 (2017): 2021-2030.
- [2] Li, Boyi, et al. "Aod-net: All-in-one dehazing network." *Proceedings of the IEEE International Conference on Computer Vision*. Vol. 1. No. 4. 2017.