

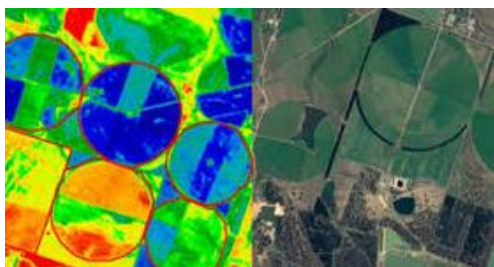


# Image Processing & Analysis

## Abstract

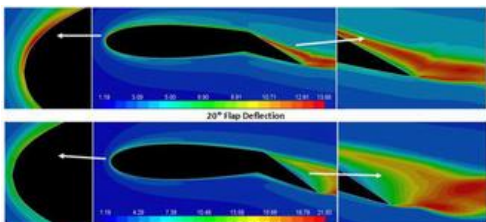
### 1.1 Introduction

As the name suggests, image processing can simply be defined as the processing (**analysing and manipulating**) of images with algorithms in a computer (**through code**) to extract useful insights (**Features Extraction**) from the image.



### 1.2 Image Processing: Chemical Engineering

Image processing techniques can be used to visualize and analyze the flow of fluids in chemical processes. This helps in understanding the behavior of fluids in pipes, reactors, and other equipment.



### 1.3 Objective

**Flow Visualization and analysis** of fluid through sponges. By evaluating external image processing.

## Methodology

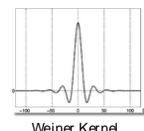
### 2.1 Image Acquisition:

The image needs to be captured (using cameras).



### 2.2 Pre-processing(Enhancement/ Restoration):

- sampling and manipulation; grayscale conversion.
- Enhance the quality of the image (filtering, deblurring).
- Restore the image from noise degradation.



Histogram

### 2.3 Segmentation:

Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images.



### 2.4 Information extraction/representation:

Some hand-crafted feature-descriptor can be computed (for e.g. introducing different colours to the gradient of edges.)



$$\theta = \tan^{-1} \left( \frac{\partial f / \partial y}{\partial f / \partial x} \right)$$



$$\|\nabla f\| = \sqrt{\left(\frac{\partial f}{\partial x}\right)^2 + \left(\frac{\partial f}{\partial y}\right)^2}$$

## Conclusion

### Result:

We have represented the directional information which is valuable in texture analysis. Different textures may exhibit specific directional patterns, and understanding these patterns can contribute to Directional analysis of Orientation and motion.

### Different Methods of Feature Extraction:

#### Morphological Feature Extraction:

Morphological operations such as erosion and dilation are used to extract features like edges and boundaries.



### Convolutional Layers:

CNNs automatically learn hierarchical features from raw data. Convolutional layers use filters to detect patterns like edges, textures, and shapes.

### References

- [https://www.cis.rit.edu/~cnspci/references/dip/feature\\_extraction/harris1988.pdf](https://www.cis.rit.edu/~cnspci/references/dip/feature_extraction/harris1988.pdf)
- <https://github.com/PacktPublishing/Hands-On-Image-Processing-with-Python>

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