

# EE604: Image Processing

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DR. TUSHAR SANDHAN

# Instructor

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- Dr. Tushar Sandhan
  - Office: EE dept, ACES 408
  - Other details: <https://home.iitk.ac.in/~sandhan/>
  - Teaching, creating assignments and exams
  - Evaluating theory questions

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  - Teaching, creating assignments and exams
  - Evaluating theory questions
  
- Teaching assistants (TA)
  - Programming assignments, MCQ, numerical Qs evaluation
  - Dedicated TA for responding email, forum queries
  - Attendance and TA management

# Introduction

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- Image

- How an image is being made
- Biological visual systems
- Image formation models

- Processing

- Image feature representations
- Color and multi-resolution signal processing
- Segmentation, denoising, compression

# Topics

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- EE604: Image Processing
  - Human visual system
  - Elements of visual perception
  - Image formation models
  - Sampling and quantization
  - Image enhancement
    - Spatial domain
    - Frequency domain
  - Color image processing
  - Edge detection
    - Parametric
    - Non-parametric

# Topics

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- EE604: Image Processing
  - Human visual system
  - Elements of visual perception
  - Image formation models
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  - Image enhancement
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  - Color image processing
  - Edge detection
    - Parametric
    - Non-parametric

- EE604: Image Processing
  - Multi-resolution analysis
  - Image segmentation
    - ML algorithms
  - Image denoising
  - Image feature spaces
  - Image quality measures
  - Image compression
  - Morphological image processing

# Reference Materials

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- 'Digital Image Processing', R.C. Gonzalez and R.E. Woods
- IEEE Conference on Computer Vision and Pattern Recognition (CVPR)
- IEEE International Conference on Computer Vision (ICCV)
- IEEE Transactions on Image Processing (TIP)
- IEEE International Conference on Image Processing (ICIP)

# Prerequisites

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- None
- Basics of Linear Algebra
- Basic python programming
- Imp: Fourier Transform
- Imp: Integrity

```
1  # Python script to find the max
2  def maximum(a, b):
3      if a >= b:
4          return a
5      else:
6          return b
7
8  # inputs
9  a = 2
10 b = 4
11 # output
12 print('Max value is: ', maximum(a, b))
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2  a=2;b=4
3  maximum = lambda a, b:a if a > b else b
4  print(f'{maximum(a,b)} is a max value')
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➤ Do not get involved in academic misconduct or plagiarism.

"Plagiarism is the representation of another author's art, thoughts, ideas, programming code, designs or expressions as one's own original work."

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# Attendance

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- No weightage
- No daily attendance
- But

# Attendance

---

- No weightage
- No daily attendance
- But
- sometimes random draws
  - If drawn for  $i^{th}$  class:  $\alpha_i = -1\%$
- Others can fill (online form) the sample space for random draws
  - If correct sample:  $\rho_i = +0.5\%$
- Final attendance
  - Percentage:  $= \min(5, \max(-10, \sum_i \alpha_i + \sum_i \rho_i))$


# Grading Policy

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- Relative grading
- A\* (10), A (10), B+ (9), B (8)
- C+ (7), C (6), D+ (5), D (4), E (0), F (0), I (0)
  
- Assignment-1 [15%]
- Assignment-2 [15%]
- Assignment-3 [15%]
- Assignment-4 [15%]
- Quiz – 1 [5%]
- Mid-term [15%]
- End-term [20%]

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  - Mid-term [15%]
  - End-term [20%]
- 
- [15%] flexible, so might be added to some exams

# Assignment due dates

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- Lot of complications for extending due dates
  - Due to large class size
  - TAs have other work (research, courses) apart from this course
  - Unfair for those who sincerely submit on time
- Enough time will be given for each assignment
- If delayed submission 'allowed' in any of the assignments then only with -1% per day penalty.
  - means timely submissions are always getting rewarded

# Vulnerabilities

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- PG (36 credits/sem)
- UG (54~67 credits/sem)
  - Need special mentions



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- UG Batches
  - Y19 (BT-MT)
  - Y19 (BT)
  - Y20 (completed summer projects)
  - Y20 (new)

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  - Need special mentions
- UG Batches
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  - Y19 (BT)
  - Y20 (completed summer projects)
  - Y20 (new)
- Vulnerable population (if not sincere)
  - Y19 (BT)
  - Y20 (new)

# Add-drop

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- Possibility of group projects
- Course logistics become difficult if flexible dropping allowed

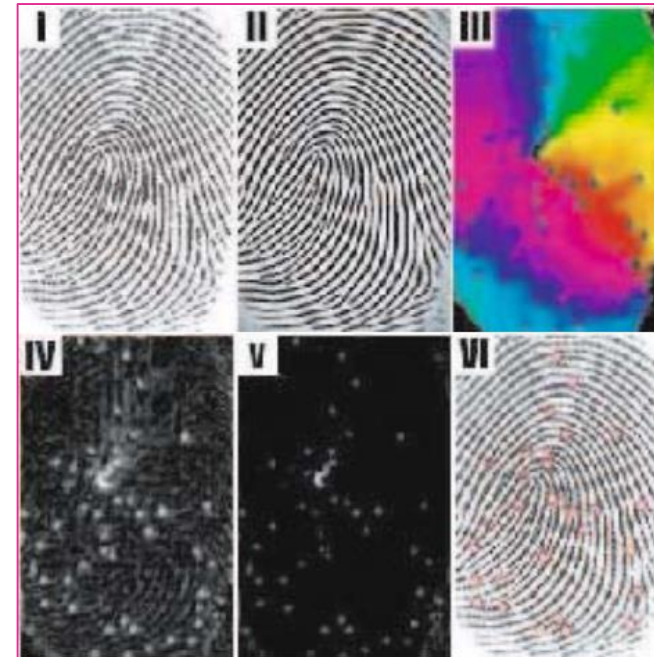
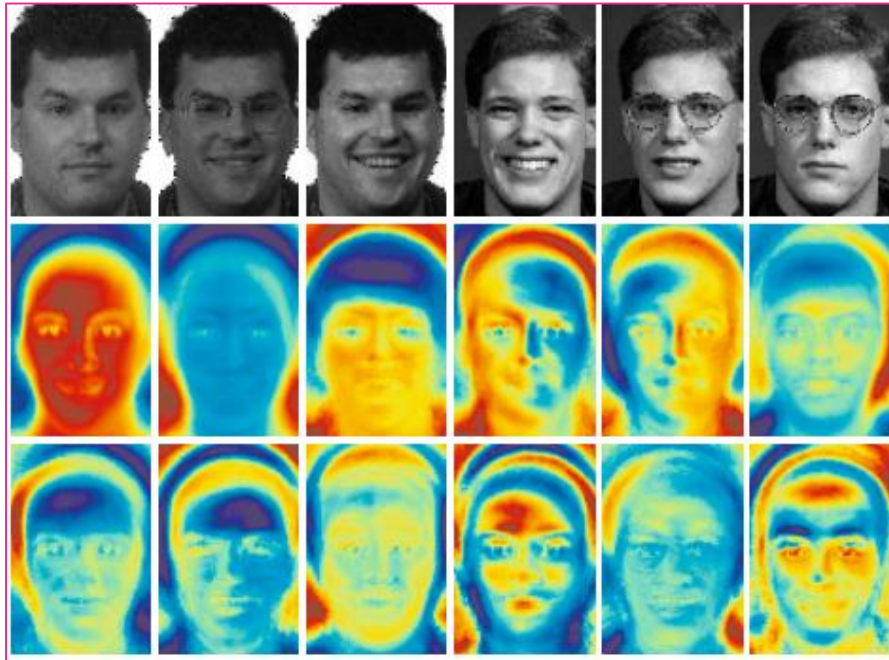
# Add-drop

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- Possibility of group projects
- Course logistics become difficult if flexible dropping allowed
- So irrespective of the academic calendar specifications,  
“this course dropping will not be accepted after 5<sup>th</sup> August”
- You can add-drop or drop-add whatever you want until 5<sup>th</sup> August.  
(either drop early, or ride the train till the end)

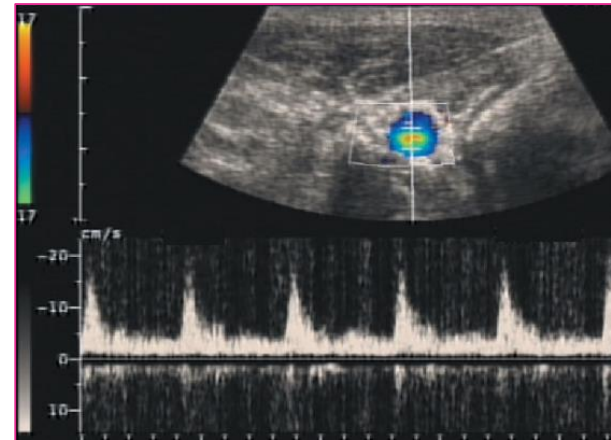
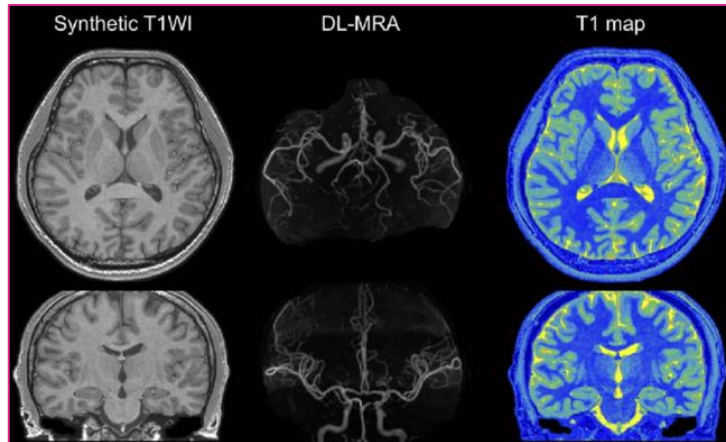
# Image Processing applications

- Biometrics



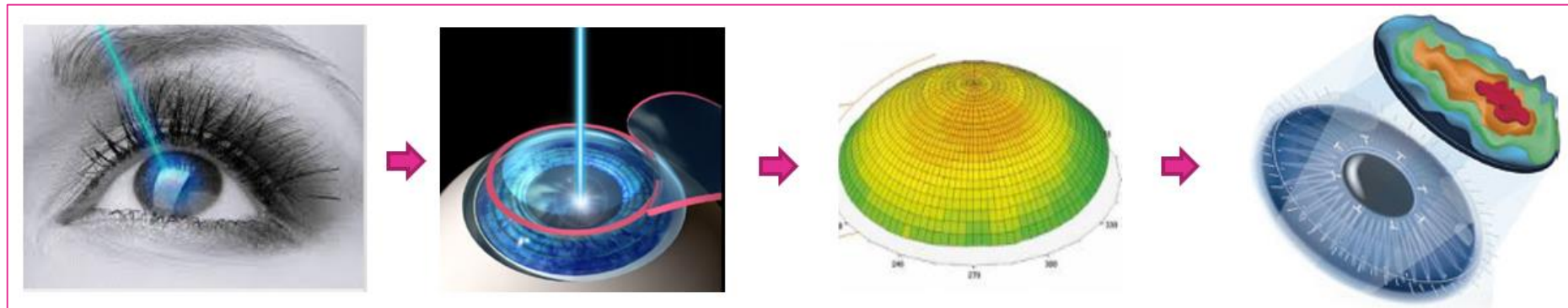
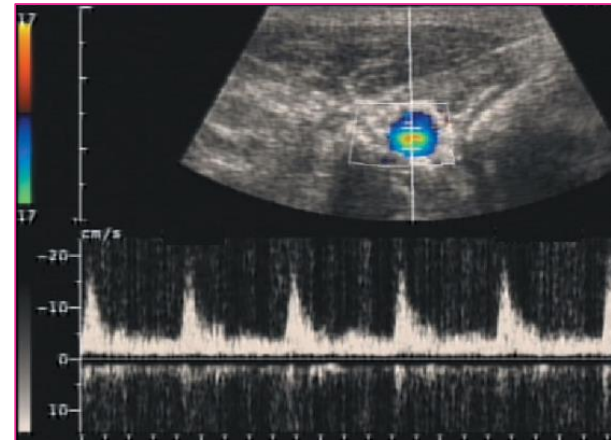
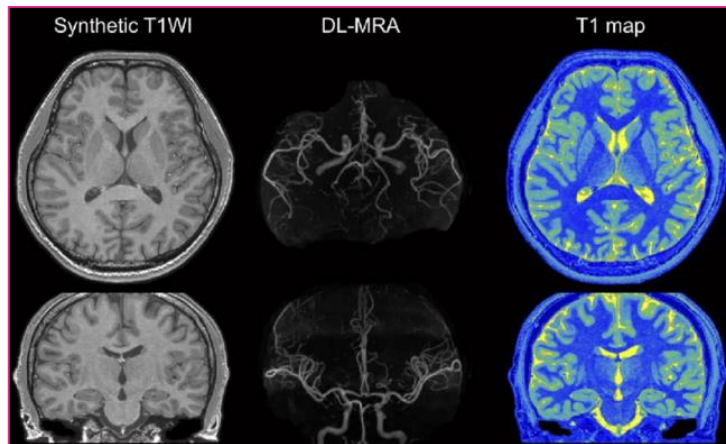
# Image Processing applications

- Healthcare, biomedical image processing
  - Cancer detection



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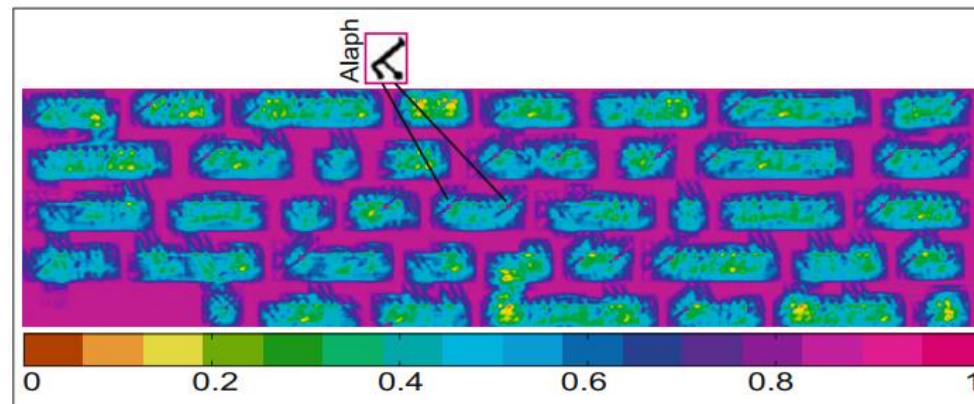




# Image Processing applications

- OCR
  - aramaic

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Alaph Mim Tau

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# Image Processing applications

- Remote sensing



Image credit: NASA

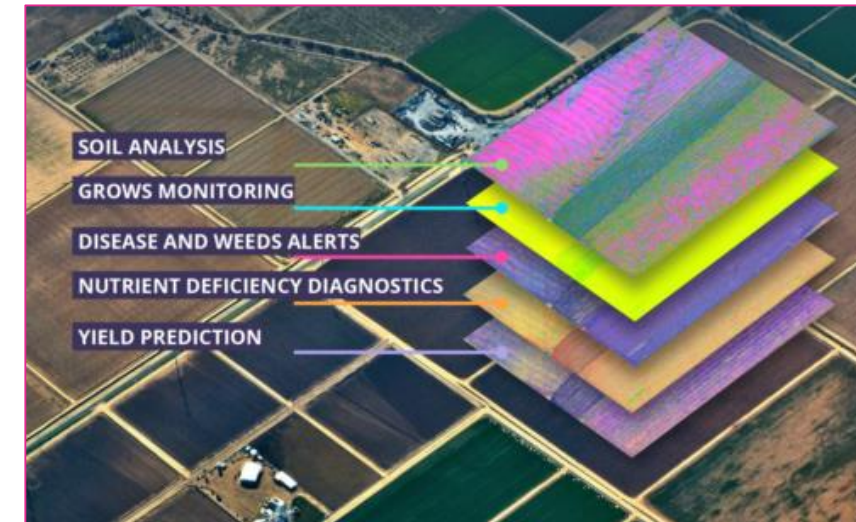
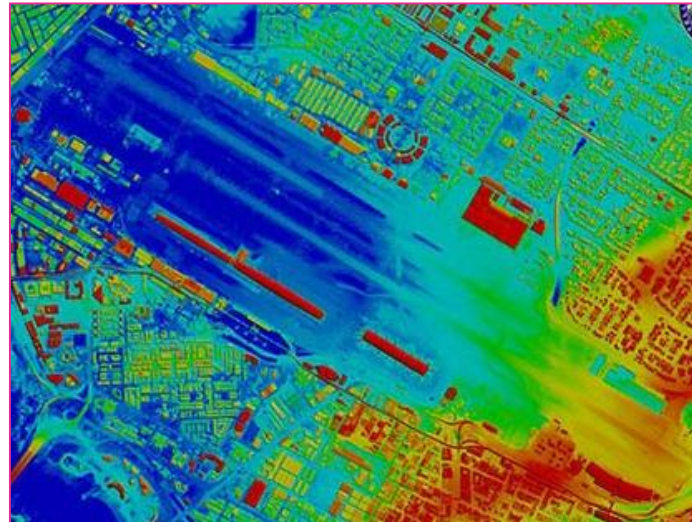
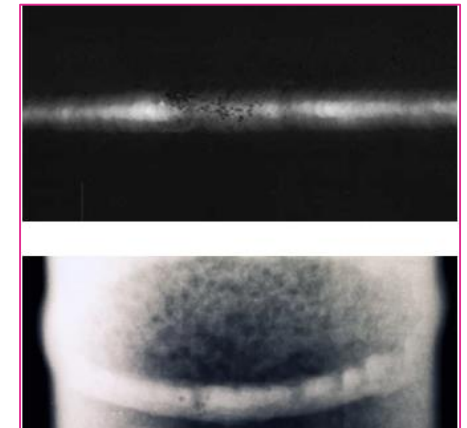
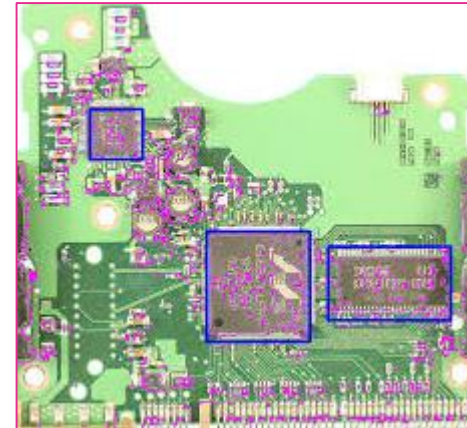
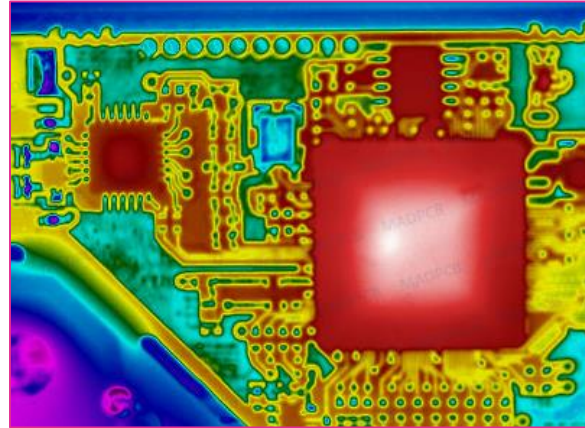


Image credit: Marita Thushari

# Image Processing applications

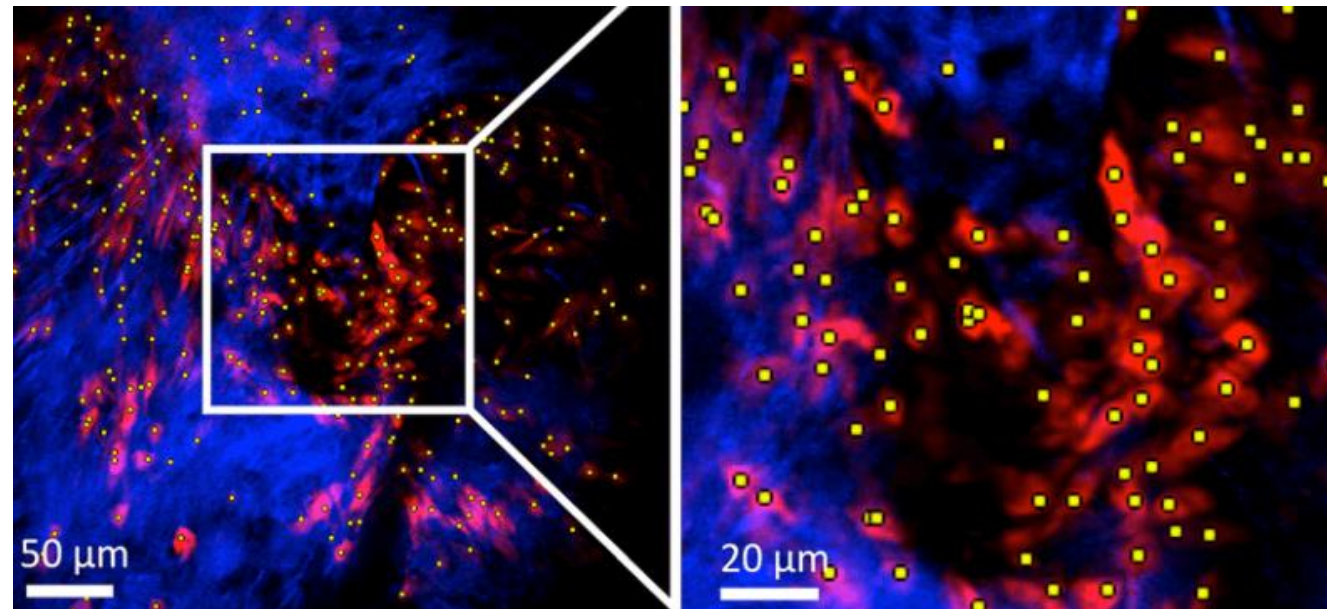
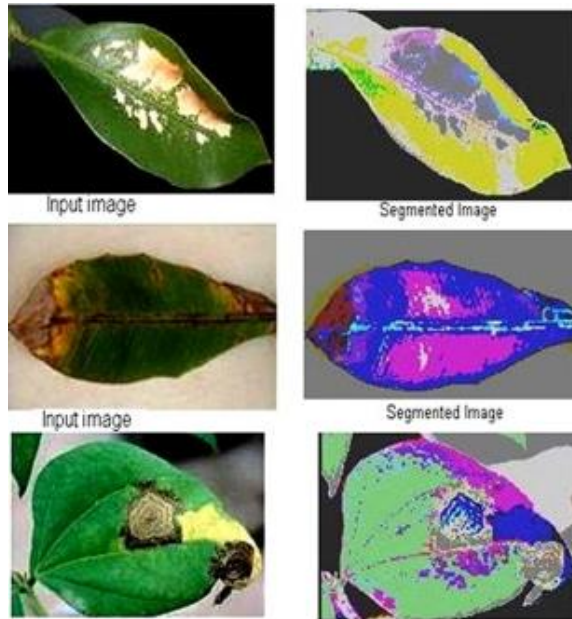
- Circuits to metals





# Image Processing applications

- Nature to biology



# Image Processing applications

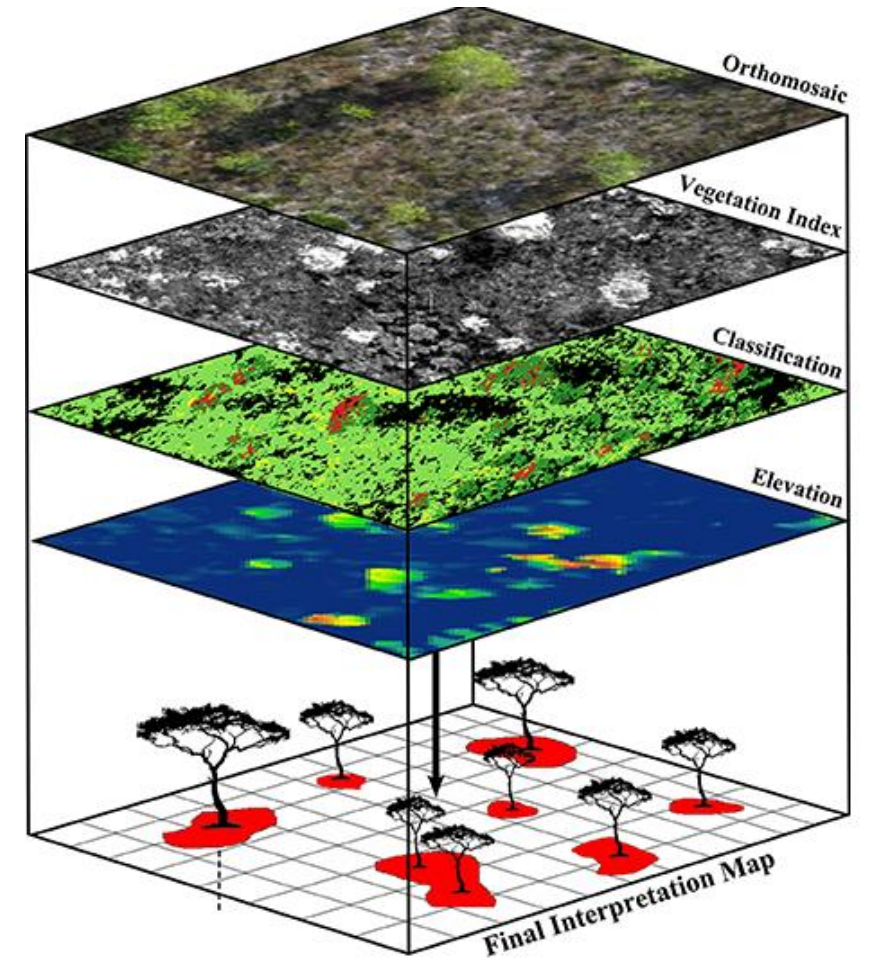
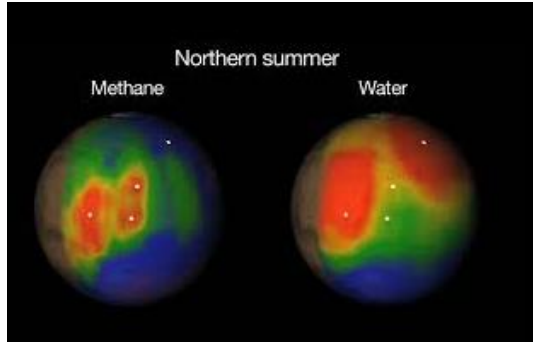
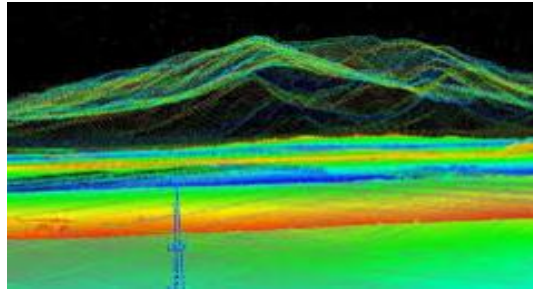
- Autonomous navigation





# Image Processing applications

- Drones to satellites



# Image Processing applications

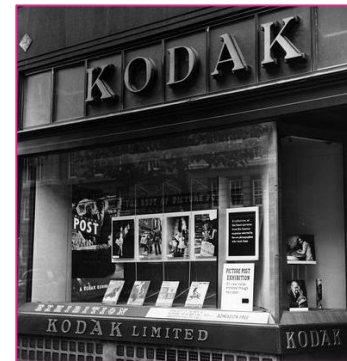
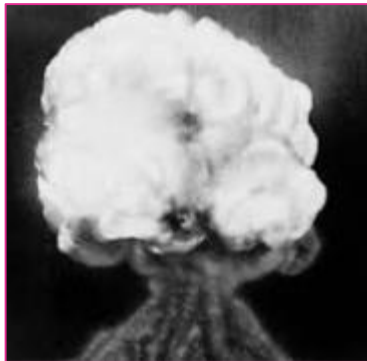
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