ITMO

Introduction

Image Processing

Introduction

Syllabus

- **Teachers:**
  - Ph.D, Associate Professor, Sergei Shavetov, s.shavetov@itmo.ru
  - Ph.D, Associate Professor, Andrei Zhdanov, adzhdanov@itmo.ru
  - Ph.D, Assistant Professor, Oleg Evstafev, oaevstafev@itmo.ru
  - Assistant Professor, Anatoliy Lysykh, lysykhai@itmo.ru

- **Course structure:** 16 lectures * 45 minutes each
- **After each 8 lectures:** intermediate test (two intermediate tests at all)
- **Practical assignments:** 4
- **Final test**

Detailed Course Structure

- Introduction. Main Tasks
- General Properties
- Images Filtering. Low-Pass Filters
- Edge Detection. High-Pass Filters
- Geometric Transformations
- Morphological Analysis
- Getting of Color Digital Images
- Digital Video Sequences
- Physical Nature of Light and Color
- Color Models
- Colors Selection. Color Temperature
- Images Intensity Transformations
- Getting of Digital Image
- Compression Algorithms and Storage Formats
- High Dynamic Range
- Images Gamma-Correction

Practical Assignments Topics

- Histograms, Profiles, Projections
- Filtering and Edges Detection
- Geometric Transformations
- Morphological Analysis

Files Exchange

- **DingTalk Group / Files:**
  - Movies
  - Presentations
  - Tasks
  - Templates

Course Assessments

- **2 intermediate tests:** 10 points each (20 max)
- **4 practical assignments:** 10 points each (40 max)
- **Final test:** 40 points
- **Course assessment:**
    - 60 points and more – **pass**
    - 59 points and less – **fail**

Course Deadlines

ITMO

- Practical assignments are performing in the groups of 1-3 students.
- For getting the **maximum points** for each practical assignment you should perform all tasks correctly and show it in the class.
- The **soft deadline** for each previous practical assignment is the **start of the next practical assignment**.
    - In some tasks you may earn extra points for extra tasks. If you don't have enough time to finalize your work in class, you need to finalize it before the next PA.
- The soft deadline means, that total score per each practical assignment will decrease -1 point for each day after the soft deadline date.

Reasons for Points Decreasing

- **Unperformed task** (-1 score or more depending on complexity of the task).
- Submitting reports after the **soft deadline** (-1 score or more depending on the delay time).
- **Copy-paste** from your colleagues' reports (in this case you cannot get more than 3 scores, and it will be very difficult to pass this course)

Practical Assignments Frameworks

- **MATLAB including:**
  - Digital Image Processing Toolbox,
  - Computer Vision Toolbox.
- **Python developer package with:**
  - NumPy,
  - OpenCV.
- **Microsoft Visual Studio including:**
  - Desktop Development with C++,
  - OpenCV.

Literature

- Rafael C. Gonzalez, Richard E. Woods. Digital Image Processing (4th Edition) // Pearson, 2017.
- David A. Forsyth, Jean Ponce. Computer Vision: A Modern Approach (2nd Edition) // Pearson, 2011.
- Linda G. Shapiro, George C. Stockman. Computer Vision // Pearson, 2001.
- https://www.mathworks.com/help/vision/index.html

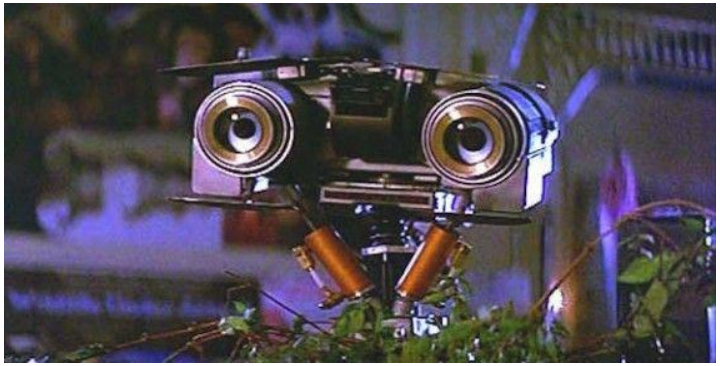
Main Tasks

Image Processing Purposes

- **Digital image processing** is any changes in data represented as digital images.
- Purposes of image processing
  - Human visual perception
    - quality improvement
    - color and contrast correction
    - correction of noise or image distortion
  - Automatic analysis
    - filtering
    - mathematical morphology
    - segmentation to some specific classes
    - objects detection, etc.

From Image Processing to Technical Vison

- Technical vision as a set of knowledge areas:
  - Image processing
  - Computer vision
  - Pattern recognition
  - Images understanding
  - Machine vision
  - Robots vision
  - Digital photogrammetry



Definition

- **Technical vision** is a combination of technical devices and software products allow for hardware device (in particular, a computer or a mobile robot) to adequately perceive and interpret the surrounding reality.

Modular Paradigm (David Marr)

- Image processing is carried out sequentially:
  - from the «iconic» representation of objects (bitmap image)
  - to the «symbolic» representation (vector and attribute data in a structured form).

Image Processing Methods

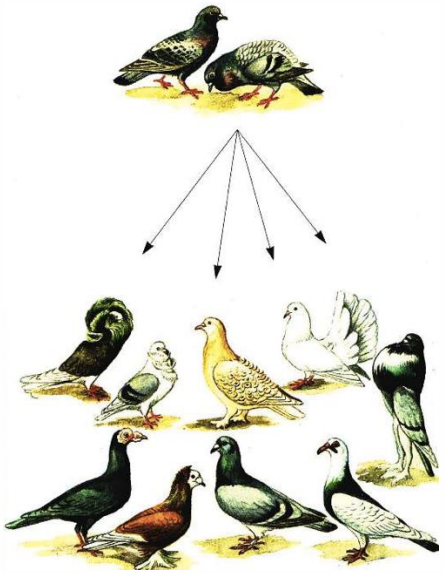
- **By levels:**
  - Low — does not use additional knowledge, models and information about the objects represented in the image
  - Medium — additional information is partially used
  - High — image context are widely used
- In this course we will consider **low level** image processing methods

Computer Vision Levels

- Images preprocessing (filtering)
- Images (scene) segmentation
- Determining of geometric structure and description
- Determining of relative structure and semantics

Reasons of Tasks Complexity

- A variety of brightness-geometric images properties
- Variability in images
- Information support of understanding scenes process



THANK YOU
FOR YOUR TIME!

ITMO more than a UNIVERSITY

s.shavetov@itmo.ru