Final Exam Study Guide

• *Midterm material (see midterm exam guide)*

• **Segmentation Using Region Detection**
- Properties of good segmentation
- Thresholding (main ideas and issues, histogram-based, hysteresis thresholding, optimal thresholding (study well - need to remember formulas), Otsu'smethod (study well - no formulas), optimal thresholding vs Otsu's method, effect of illumination, local thresholding, variable thresholding)
- Region growing (main ideas and issues, surface-fitting-based (do not need to remember all the steps in detail)
- Region merging (main ideas and issues, hypothesis-testing-based (study very well, need to remember equations), remove weak boundaries) remember
- Region splitting (main ideas and issues, steps)
- Region splitting and merging (main ideas and issues, steps)

• **Region Extraction**
- Connected components (study very well - need to remember the steps)

• **Region Representation**
- array-based, hierarchical, quad-tree-based, region adjacency graph, distance transform and skeleton (need to know how to compute them)

• **Corner detection**
- main ideas and steps, practical issues

• **2D and 3D geometric transformations**
- translation, rotation, scaling (be more careful in 3D case)
- homogeneous coordinates
- composition of transformations (be careful about the order)
- rigid, similarity, affine
- change of coordinate systems

• **Singular Value Decomposition**
- study very well! (need to remember equations)
- what is it? why is it useful?
- relation to eignevalues/eigenvectors of $A{Asup T}$ and ${A sup T}A$
- computing rank, inverse, matrix condition
- overconstrained systems (least-squares solution), homogeneous system
- enforce constraints (e.g., orthogonality, rank)

• **Image Formation**
- model of image formation, camera optics
- CCD cameras, frame grabber, frame buffer
- major coordinate systems and their relationship in recovering the 3D to 2D transformation.

• **Projection Models**
- pinhole camera, perspective projection (equations), terminology
- properties of perspective projection, vanishing points and lines
- orthographic projection (equations), properties
- weak perspective projection (equations), properties

• **Camera Parameters**

- extrinsic camera parameters (equations)
- intrinsic camera parameters (equations)
- 3D to 2D transformation (equations)
- projection matrix (combine extrinsic with intrinsic)

• **Camera Calibration**
- what is the goal? How is it done? (correspondences)
- direct parameter calibration (no equations but remember how it is done)
- camera calibration using the projection matrix (equations for step 1, remember how the whole algorithm works)

• **Stereo**
- what is stereo? terminology
- how stereo works? (triangulation principle - equations)
- main problems: correspondence + reconstruction
- stereo parameters: extrinsic + intrinsic

• **Stereo correspondence problem**
- what is it? why is it difficult?
- two methods: correlation-based, feature-based
- how correlation-based methods work? (equations)
- what are the main parameters of correlation-based methods? how can we choose them?
- how feature-based methods work?
- comparison between correlation-based and feature-based methods

• **Epipolar Geometry**
- What is the epipolar constraint, why is it important/useful?
- What is the essential matrix? what information does it encode? why is it useful? (equations)
- What is the fundamental matrix? what information does it encode? why is it useful? (equations)
- Eight-point algorithm (equations)
- how to find epipoles and epipolar lines?
- what is rectification? How is if done? (no equations, only idea) Why is it useful?

• **Stereo Reconstruction**
- Three main methods: (1) known extrinsic and intrinsic, (2) known intrinsic, (3) neither extrinsic or intrinsic are know.
- how does the first method work? what is the main problem? (no equations)
- how does the second method work? what are the main steps? (no equations)