**Course Title:** 3D Modeling and Reconstruction

**Class:** PhD

**Semester:** 1

**Session:** 2020

**File Type:** PowerPoint Presentation

**Instructors:** Dr. Saima Farhan

**Link:**

**<https://drive.google.com/drive/folders/1RRd8Yw-lnmECDQQuru7l608RWPmTsIky?usp=sharing>**

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| S. No. | Course Content |
| 1 | 2D models, introduction to 3D models and their applications, creation and representations of 3D models. 3D reconstruction, 3D modeling, reconstruction vs. modeling, meshing. |
| 2 | Creation of 3D models, 3D models as collection of data, manual modeling, procedural modeling, scan bassed modeling, wireframe modeling, 3D surface modeling, solid modeling, modeling process, polygon modeling, curve modeling, digital sculpting. |
| 3 | Geometry and topology of a 3D model, manifold and non manifold models, geometry primitives, operations on primitives, properties of solid models, constructive solid geometry (CSG): primitive based CSGs, data structures for CSG, building operations, algorithms. |
| 4 | Boundary representation (B-rep): adjacency topology, object modelling using B-rep, B-rep data structures, building operations, validity of B-rep models. |
| 5 | Stereoscopy: stereoscopic imaging, depth perception, stereoscopic vision. |
| 6 | Digital acquisition of an image: non-contact scanners- laser triangulation, time of flight. |
| 7 | Digital acquisition of an image: contact scanners- coordinate measuring machines, design of CMM, data collection and reduction system. |
| 8 | Camera projections, perspective projection, pin hole camera principle, orthographic projection, camera perspective, camera angles, normal angle, high angle, low angle, canted angle, subjective angle, transformations, geometric operations: scale, rotate, reflect, translate, affine transformation. |
| 9 | Evolution of solid modeling, scene modeling and reconstruction, photorealistic scene reconstruction. |
| 10 | Depth recovery, image calibration, lens models, distortions, exposure differences between images, vignetting, camera response, chromatic aberrations, camera calibration, compound lens imaging, camera and calibration target, calibration procedure, central projection, transformations from lengths to pixels, internal camera parameters, from camera coordinates to world coordinates, homogeneous coordinates, projection matrix, direct linear transformation, radial distortion, radial distortion modeling. |
| 11 | Hidden surface elimination, occluded surfaces visibility, back face culling, viewing frustum culling, object-space techniques, image-space techniques, openGL, z-buffer, painter’s algorithm, binary space partitioning, issues in surface representation. |
| 12 | Texture mapping: texture mapping methods and applications, techniques for correspondence, texture mapping in openGL pipeline, UV mapping, rectangular surface texture mapping, parametric surface texture mapping. |
| 13 | Mapping functions, backward mapping, planar mapping, cylindrical mapping, spherical mapping, box mapping, intermediate objects, procedural textures, texturing triangles, interpolation, magnification, minification. |
| 14 | Feature tracking, overlap based feature tracking, attribute based feature tracking, higher dimensional isosurfacing based feature tracking, machine learning based feature tracking, time activity curve based distance fields for time varying features, applications of feature tracking. |
| 15 | Multiresolution modeling, FFT, wavelets, FFT vs. Wavelets, scaling, shifting, non-stationary property of natural images, pyramid image structure, refinement equation for multiresolution modeling. |
| 16 | Volume techniques for 3D reconstruction, shape from silhouette, rendering of volumetric models, voxel volumes, octree representation of voxel volumes, space carving, epipolar image analysis. |