Chapter 1

**Medical images, unlike photography:**

* X-ray Absorption: Medical images show things by seeing how much X-rays are absorbed, not by reflecting light.
* Exact Object Delineation: They're more about clearly showing what's there, not just detecting shapes.
* Variations in Shape and Appearance: They capture differences in how things look for evaluation.
* Analysis Methods: They focus on techniques like making things clearer, fixing them up, making them better, and matching them together.
* Fusing Images: They're about combining images from different places, not just figuring out what's in them or making 3D models.

1. Delineation: Drawing clear lines around objects in an image.
2. Restoration: Fixing or improving the quality of an image.
3. Enhancement: Making an image clearer or more detailed.
4. Registration: Aligning and merging multiple images together.

**Analysis of medical images:**

- Computer-assisted analysis aids experts (radiologists, surgeons) in decision-making.

- Different analysis tasks correspond to specific decision needs:

- Delineation (segmentation task): Defining object boundaries.

- Detection (classification task): Identifying objects.

- Comparison of object appearance (registration task): Aligning images from different times or modalities.

**Image Analysis in Clinical Workflow:**

1. Clinical Study: Doctors look at images to understand or confirm findings. They're usually put on a special computer.

2. Large Cohort Studies: Computers help analyze images because there are lots of people involved.

3. Computer Aided Diagnosis support: Doctors use computers to look at lots of images for one patient to help figure out what's wrong.

4. Treatment Planning: Doctors look at images before they start treating a patient.

5. Computer-Assisted Surgery: Images help doctors during surgery to make sure they're doing it right.



**Using Tools in Medical Image Analysis:**

1. **Viewer Software:**
   * Used for accessing and examining image data.
   * Helps organize data and discuss solutions with experts.
   * Example: MicroDicom viewer for viewing DICOM images.
2. **Analysis Software:**
   * Provides parameterizable analysis modules for various image analysis tasks.
   * Examples: MevisLab for commercial and non-commercial use, offering intuitive interfaces.
3. **3D Slicer:**
   * Open-source software for segmentation, registration, and analysis of medical images.
   * Provides user interfaces for various modules and allows combining them for processing pipelines.
4. **Rapid Prototyping Programming Language:**
   * MATLAB or IDL are interpreter languages suitable for rapidly processing image arrays.

**Software Libraries:**

- OpenCV for general image processing and computer vision tasks but lacks support for 3D or 4D scenes.

- ITK (Insight Toolkit) focuses on segmentation and registration of medical images, with extensive coverage of segmentation methods.