# ADVANCED BIO MEDICAL INSTRUMENTATION

## LECTURE 04: RADIOLOGICAL EQUIPMENTS

## DIGITAL RADIOGRAPHY

Digital radiography is a filmless technology used to record radiographic images. Here digital X-ray sensors are used instead of traditional photographic film. Digital radiography comes in two forms: direct, that connect directly to the computer via USB and provides immediate images, and indirect (photostimulable phosphor plates, or PSP) which uses plates that are radiated and then digitally scanned.

The purpose of digital imaging is to generate images that can be used in the diagnosis and assessment of dental disease. The images produced are diagnostically equivalent to film-based imaging.

Components

The essential components for digital imaging include:

- a source of radiation – X ray source
- a sensor - CCD, CMOS or PSP
- a computer

Instead of film, an intraoral sensor is exposed to radiation, and the electronic signal from this sensor is converted into digital form. The digital sensor transmits this information to a computer. Software stores the image electronically. The image can be manipulated to enhance the appearance for interpretation and diagnosis.

Less radiation is needed to generate an image because the sensor is more sensitive to radiation than conventional film; exposure times are 50% to 80% shorter for digital radiography.

1.Source of Radiation

Most digital radiography systems use a conventional dental x-ray unit as the source of radiation.

2. Sensors

CCD (Charged Couple Device): Silicon chip with an embedded electronic circuit.

PSP (Photostimuable Storage Phosphor): plastic plate coated with a photostimuable phosphor layer.

CMOS-APS (Complementary Metal Oxide Semiconductor - Active Pixel Sensor): silicon chip with an ADC for each column of pixels.

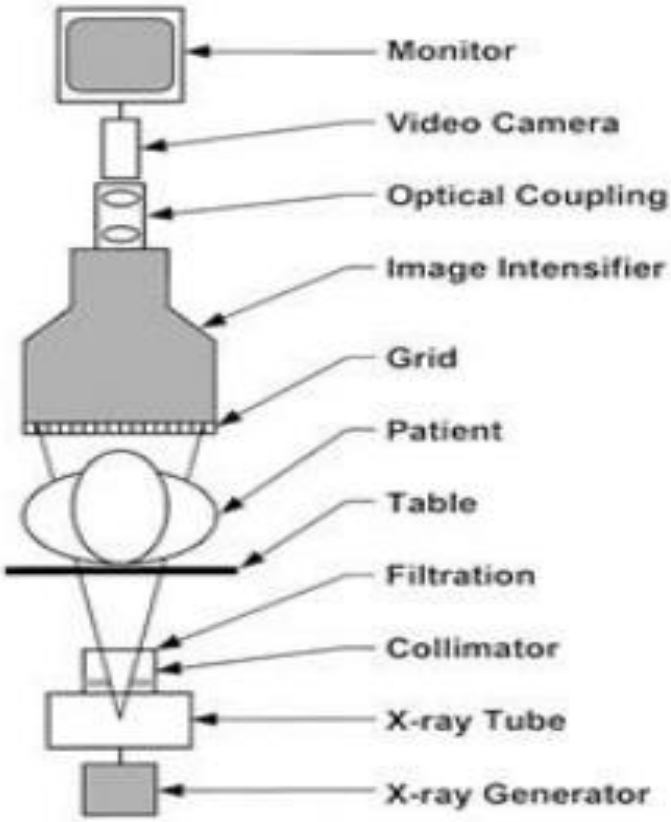
3. Computer

The computer is used to store the incoming electronic signal. Data acquired by the sensor are communicated to the computer in analog form, then converted into digital form with use of an analog-to-digital converter (ADC).

## DIGITAL FLUROSCOPY

Fluoroscopy is an imaging technique that uses X-rays to obtain real-time moving images of the interior of an object. This is useful for both diagnosis and therapy and occurs in general radiology, interventional radiology, and image-guided surgery.

Digital Fluoroscopy uses x-ray images to produce a digital moving picture sequence that can be viewed by the radiologist on a monitor.



Main Components:

X ray source

Image intensifier- Converts x rays to visible light

Detectors- Flat panel detectors

Monitor- Has low,high and highest resolution

**3.3 MAMMOGRAPHY**

Mammography is specialized medical imaging that uses a low-dose x-ray system to see inside the breasts. A mammography exam, called a mammogram, aids in the early detection and diagnosis of breast diseases in women.

During a mammogram, the breasts are compressed between two firm surfaces to spread out the breast tissue. Then an X-ray captures black-and-white images of the breasts that are displayed on a computer screen and examined by a doctor who looks for signs of cancer.

Three recent advances in mammography include digital mammography, computer-aided detection and breast tomosynthesis.

Digital mammography, also called full-field digital mammography (FFDM), is a mammography system in which the x-ray film is replaced by electronics that convert x-rays into mammographic pictures of the breast. These systems are similar to those found in digital cameras and their efficiency enables better pictures with a lower radiation dose. These images of the breast are transferred to a computer for review by the radiologist and for long term storage. The patient's experience during a digital mammogram is similar to having a conventional film mammogram.

Computer-aided detection (CAD) systems search digitized mammographic images for abnormal areas of density, mass, or calcification that may indicate the presence of cancer. The CAD system highlights these areas on the images, alerting the radiologist to carefully assess this area.

Breast tomosynthesis, also called three-dimensional (3-D) breast imaging, is a mammography system where the x-ray tube moves in an arc over the breast during the exposure. It creates a series of thin slices through the breast that allow for improved detection of cancer and fewer patients recalled for additional imaging.

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## ANGIOGRAPHY

Angiography is an x-ray technique in which dye is injected into the chambers of the heart or the arteries that lead to the heart (the coronary arteries). Doctors then measure the blood flow and blood pressure in the heart chambers and see if the coronary arteries are blocked.

A long, thin tube (called a catheter) is put into an artery in the leg and threaded into the heart. Once the catheter is in place in the heart, a dye is injected through the catheter and into the heart. The dye helps doctors see how the heart chambers and the coronary arteries are working. The movement of the dye through your heart and coronary arteries is recorded as an angiogram and viewed on a television monitor.

Reasons for Performing Angiography or Angiogram

Aneurysms -- an area of a blood vessel that bulges or balloons out, cerebral vascular disease, such as stroke or bleeding in the brain,blood vessel malformations

Other areas of the body that can be examined using angiography include the:

-brain (cerebral angiography)

-lungs (pulmonary angiography)

-kidneys (renal angiography)

-arms or legs (extremity angiography)