

Lecture 2

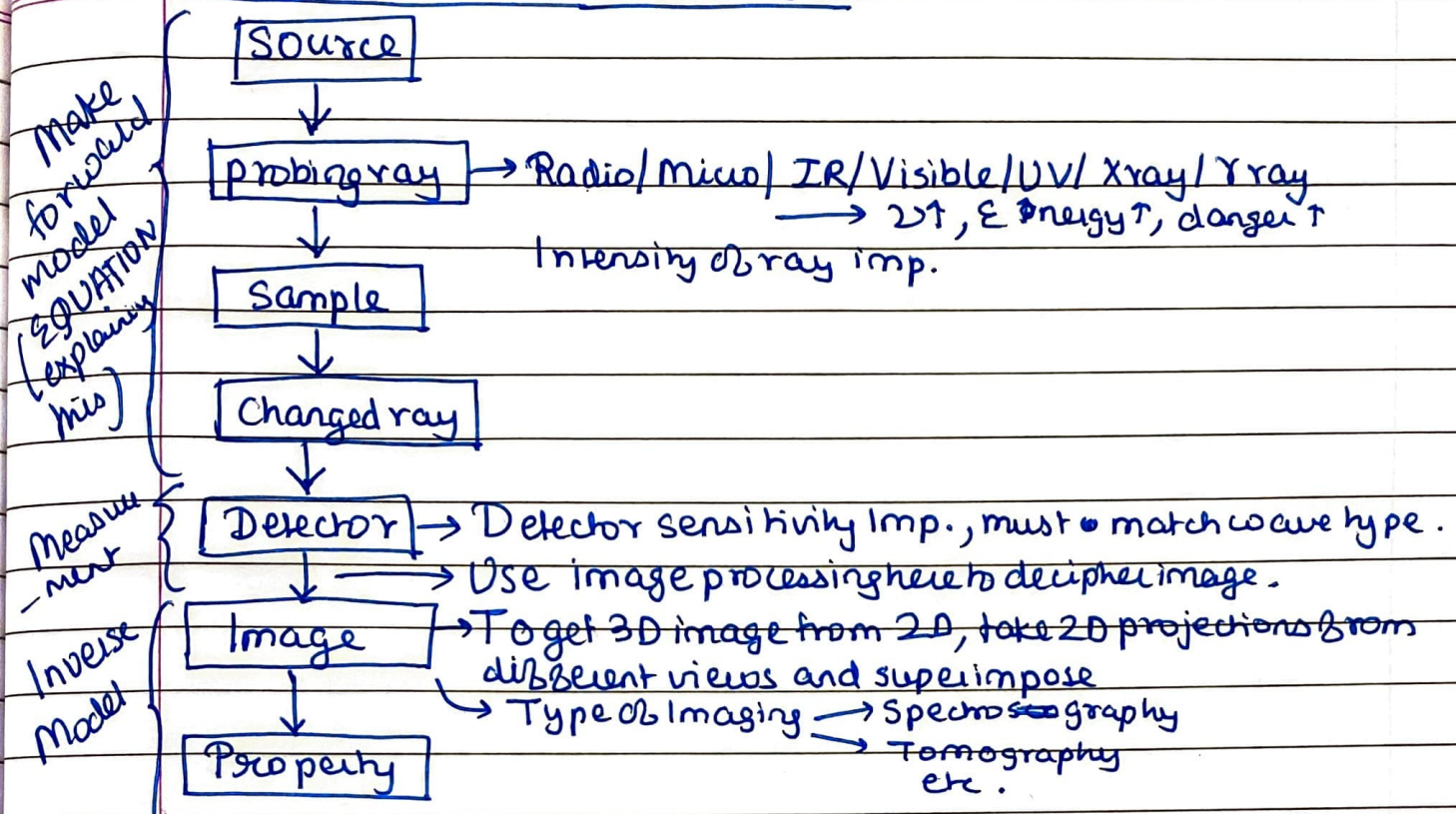
- Kinds of non invasive ^{Testing} ~~Imaging~~:
 - a) ^{Probing} EM waves (Imaging): We give energy to body, it interacts and comes out, with its properties changed
 eg. Xray, electric Impedance tomography (3D), Ultrasound, photoacoustic, CT scan, MRI, NIR, PET scan, OCT, fluorescence.
 - b) We measure signals coming from the body.
 eg. ECG, EEG, EMG, EKG, phonocardiology, temp etc.

Forward and Inverse problem in non Invasive testing ^(nondestructive)

- Forward Model: A physical/math model explaining
 - (a) How a signal is originated & propagated in object
 - OR
 - (b) How probing wave interacts with object.
 eg. Neuron action potential generated and manifests as EEG
 eg. X rays interact with human body (Beer Lambert's law)
- Measurement Model: measurement of signals (eg. using electrode/stethoscope and other detectors).
 Know what kind of properties to measure non-invasively.
- Inverse model: Given the Forward model and measurements taken, ^(body) find object properties.
 eg. Status of heart using EEG
 eg. Absorption coeffs of tissue using CT scan.

eg. MRI waves interact with H ₂ O molecule light waves scattered and refracted Thermal radiation generated by body <u>Study these and make math model explaining these.</u>	Measure light Intensity/ MRI waves after passing through body	Deduce human body property, like detect tumour/ analyse tissue using measurement and model eqn.
FORWARD	M	INVERSE

USUAL METHOD FOR IMAGING



Process to detect deformity

- We know Ideal measurements of body parameters.
- Now assume a deformity (eg tumour) and ~~we~~ guess new Synthetic measurements.
- Compare synthetic with actual measurements.
- If almost same, your guess is final. Else make a new guess to reduce error.
- Sort of like a negative feedback loop. (Reduce error).
- In such a way, optical/mech properties of the body are used for diagnosis.

Examples of Identification of object properties using certain measurements

- Which duck swimming? Using swimming pattern.
- Which food? Using smell.
- Where manhole / obstacle? Using echolocation measurements.

↑ here the echolocation process (by sound wave reflection etc) is the forward model. Measuring ^(detecting) reflected sound is the measurement model and based on that, finding obstacle is the Inverse model.

- Road crossing, driving, Identifying songs, Identify drum shape.
- Basically any situation where you experience a phenomenon and learn from it. (more examples in slides) and build a model.