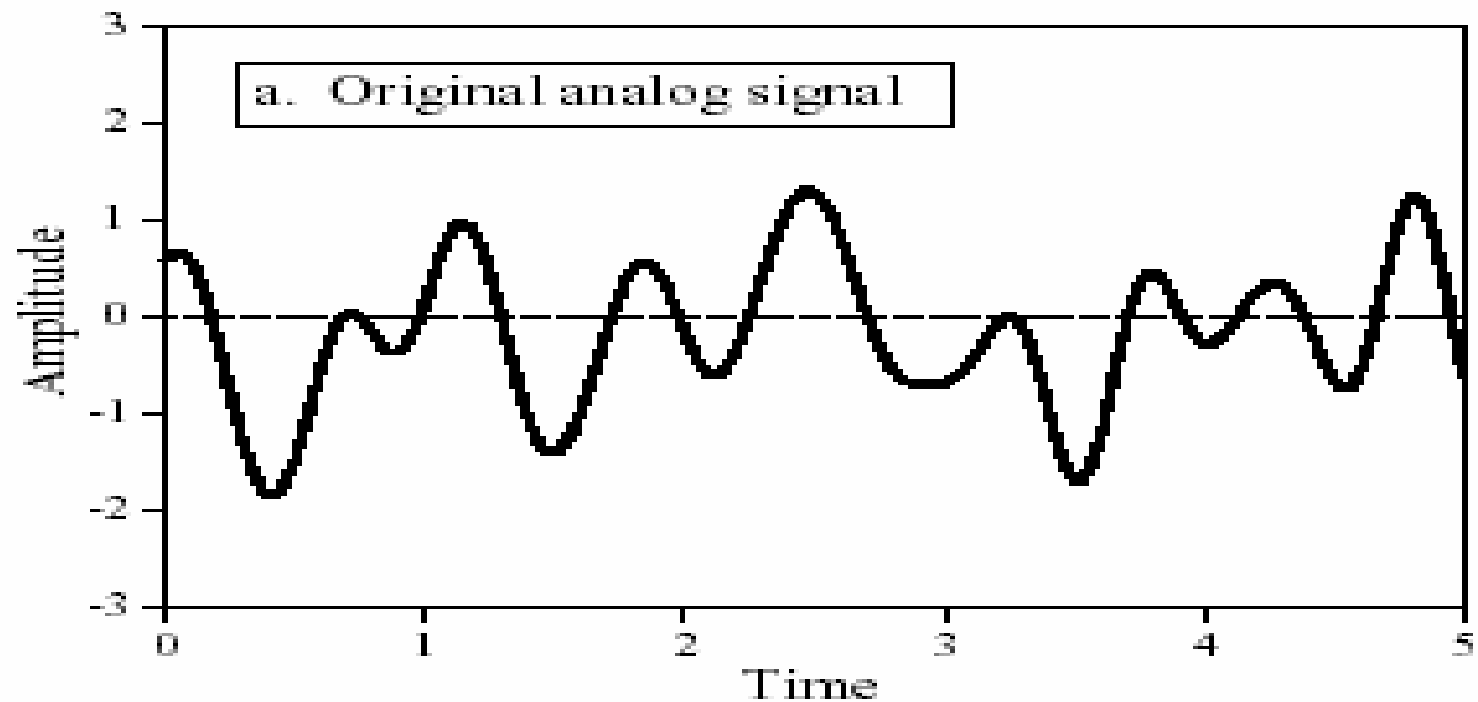


Multidimensional Image Processing

How High Can We Go?

Signal Processing

Time Domain



Signal Processing

- 1 dimensional signal – amplitude over time
- Many of the signal processing basics apply to multidimensional processing
 - quantization
 - sampling
 - filtering
 - transforms

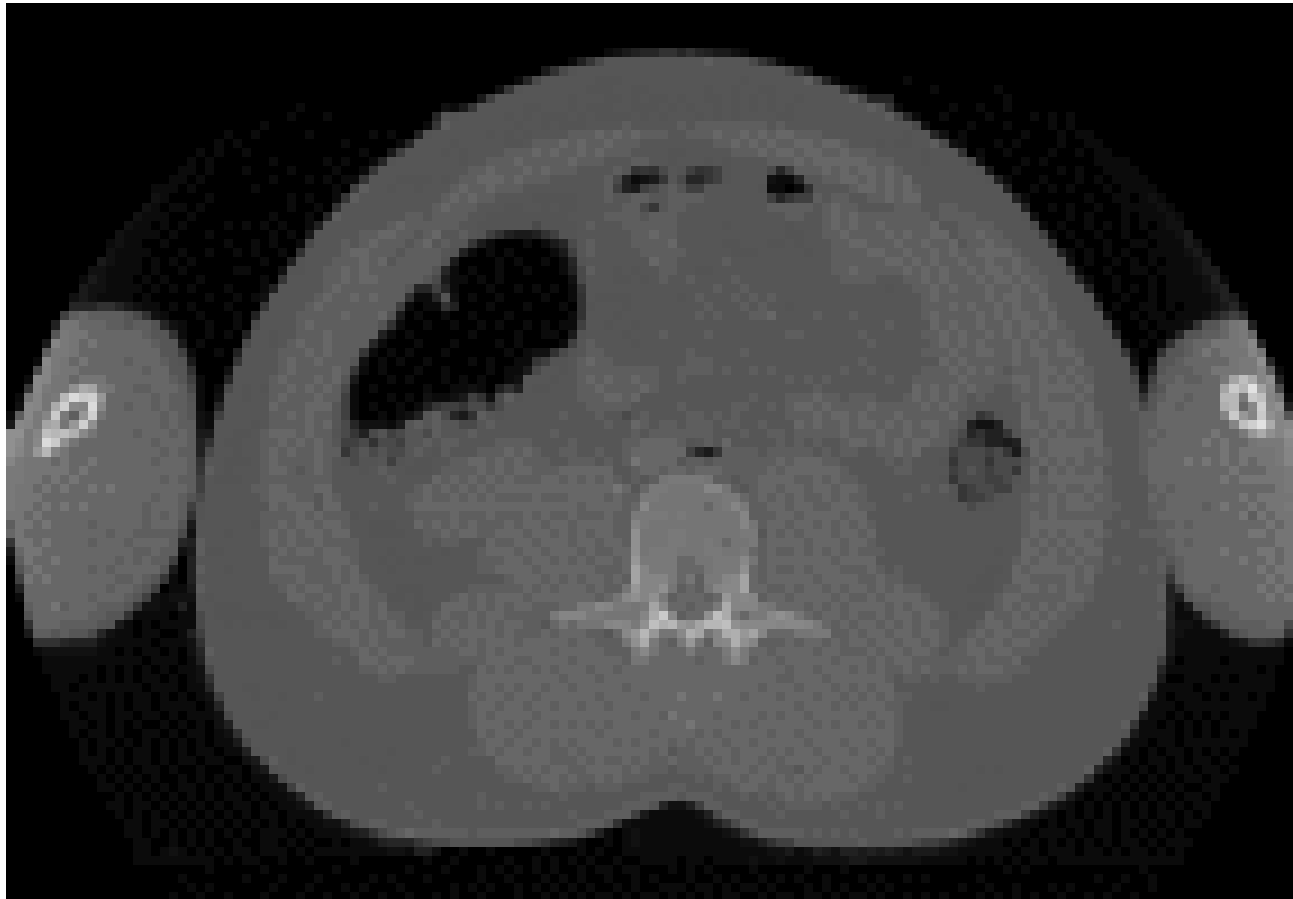
2D Images



2D Images

- X-ray is by far the most common
- The signal is x-ray attenuation over space, typically designated x and y

3D Images



3D Images

- It doesn't look very three dimensional...
- People can't see in three dimensions
 - 3D images are often displayed as a series of 2D slices
 - Visualization allows you to see 3D structures
- CT Scans use x-ray attenuation over volume – x, y, and z

3D Images



3D Images

- Ultrasound measure reflections of sound over time and two dimensions of space
- This is another way of thinking of three dimensions – combines the time dimension of signal processing and the space dimensions of image processing

Other Possibilities

- Scale space – start with a 3D image and make measurements at different scales (e.g. successively more blurring)
- The resulting set of images is called a scale space
- It exists in three dimensions – two dimensions of space and one dimension of scale

4D Images

- Pictures fail me...
- Ultrasound is becoming more available as a 4D image – using an array of sensors, the resulting image is a timed sequence of 3D images
- Other 3D imaging techniques are starting to take advantage of time sequencing

Does this End?

- Realistically, 4 is the number of dimensions in which we live, so represents a physical upper limit
- However, if we use (or extend) the previous notion of scale space, then we can “create” images of any number of dimensions...