Getting deeper into Doppler

http://en.wikipedia.org/wiki/Doppler_effect

Partially based on a lecture by James Chan: http://www.youtube.com/watch?v=ClHjOat81-U

The Doppler effect:

Observed change in frequency of a wave relative to the source frequency.

Associated with all waves (light, sound, water etc').

Due to relative motion of source and receiver or source and material from which the wave is scattered to receiver.

The Doppler effect:

In case of sound, the players are:

1. Medium in which sound propagates.
2. Source
3. Receiver
4. Reflector

The Doppler effect:

http://en.wikipedia.org/wiki/Doppler_effect

$$f = \left(\frac{c + v_r}{c + v_s} \right) f_0$$

f_0- source freq.

c - speed in medium

v_r – speed of receiver relative to medium in direction of source

v_s – speed of source relative to medium *away* from receiver

Derive for source and stationary receiver from change in λ

The Doppler effect:

Example: lets assume a race car drives at 115miles/hr coming towards us emitting a 262Hz tone. How will it appear to a stationary receiver? What if it drives away from us?

-Matlab

The Doppler effect:

Approximation, computation of 'shift':

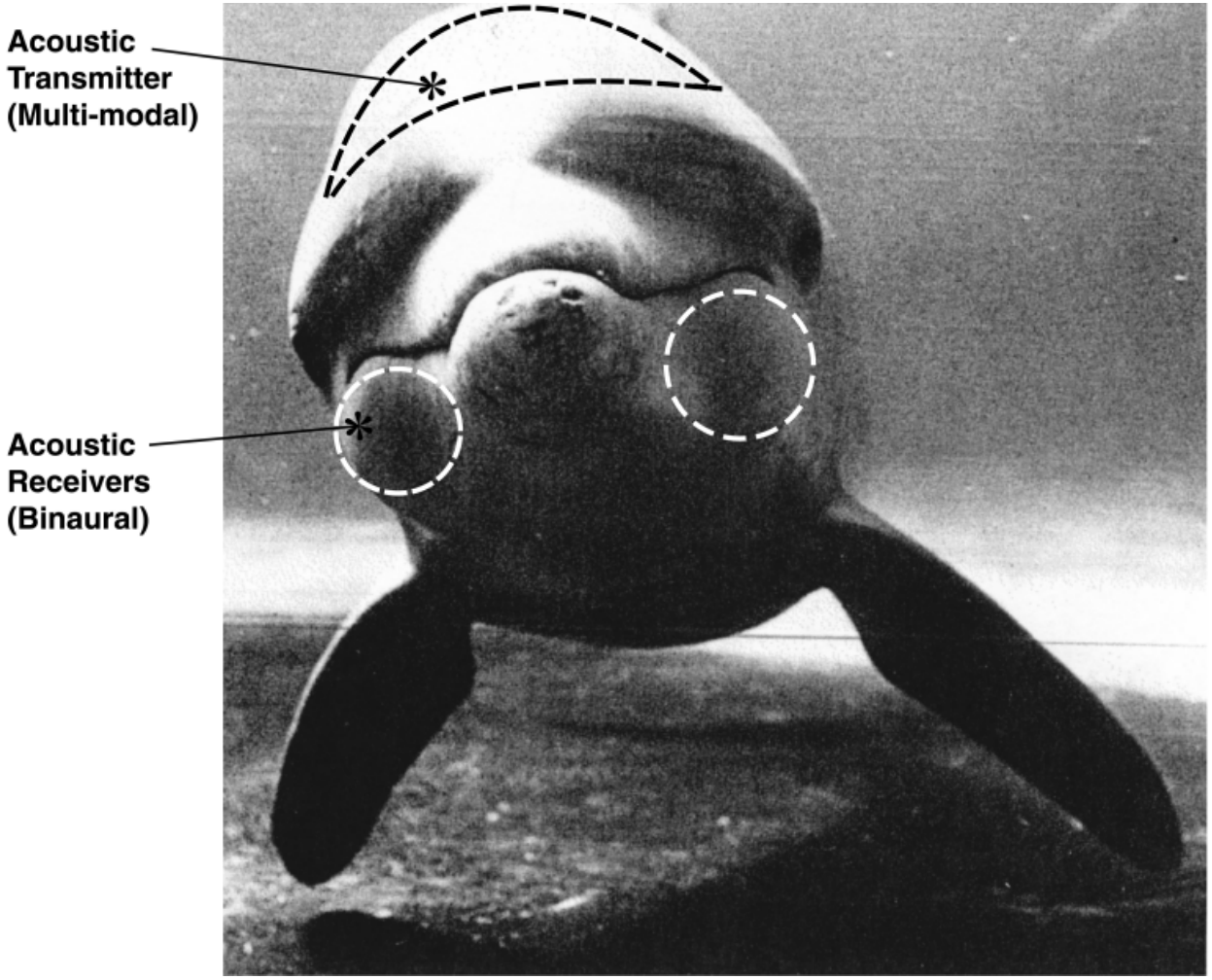
$$f = \frac{(c + v_r)}{(c + v_s)} f_0 = \frac{\left(1 + \frac{v_r}{c}\right)}{\left(1 + \frac{v_s}{c}\right)} f_0 \sim \left(1 + \frac{v_r}{c}\right)\left(1 - \frac{v_s}{c}\right) f_0 \sim$$

$$\left(1 + \frac{v_r}{c} - \frac{v_s}{c}\right) f_0 = f_0 + \Delta f$$

What if the movement in not in direction of receiver/source?

The Doppler effect:

Marine sciences-Dolphins



http://neuronresearch.net/hearing/files/dolphinbiosonar.htm

The Doppler effect:

Marine sciences – current measurements

For a reflector, we get the effect twice (once for the incident wave once for the reflected wave).

Computation of reflector velocity in the direction of the axes connecting source and receiver:

$$\left(1+\frac{2v_r}{c}\right)f_0 = f_0 + \Delta f \rightarrow v_r = \frac{\Delta f}{f_0}\frac{c}{2}$$