

Group Delay and Phase Delay (1A)

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Beat Signal

Very similar frequency signals

$$1.1 \text{ Hz} \quad \cos(2\pi * 1.1 * t)$$

$$0.9 \text{ Hz} \quad \cos(2\pi * 0.9 * t)$$

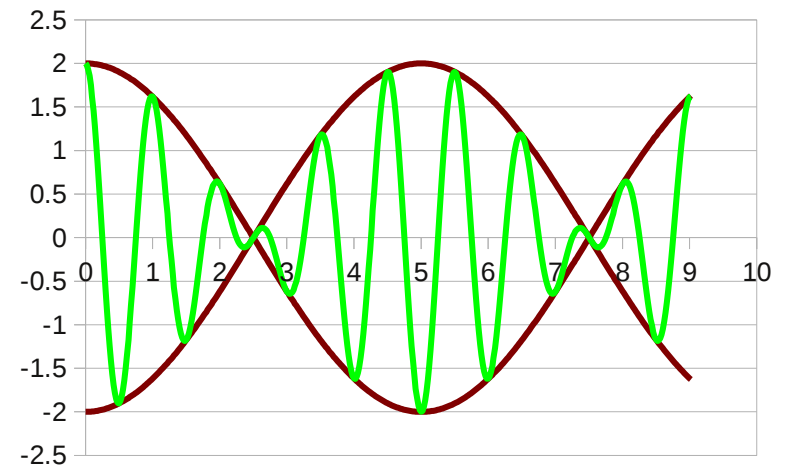
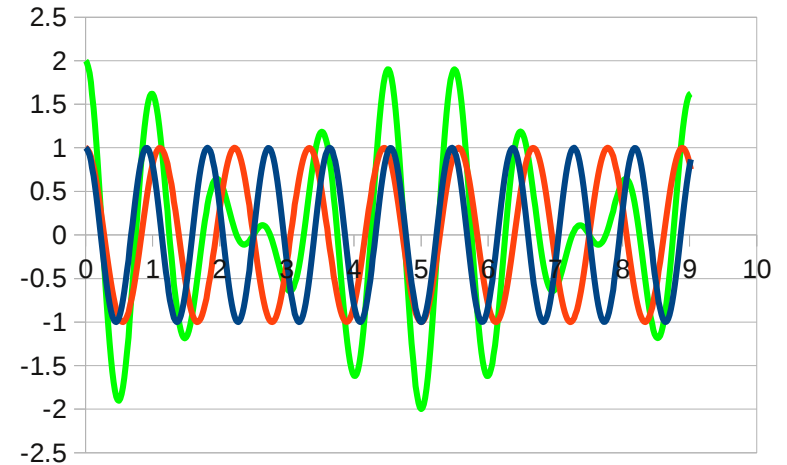
$$\cos(2\pi * 1.1 * t) + \cos(2\pi * 0.9 * t)$$

$$= \cos\left(2\pi * \frac{(1.1-0.9)}{2} * t\right) \cdot \cos\left(2\pi * \frac{(1.1+0.9)}{2} * t\right)$$

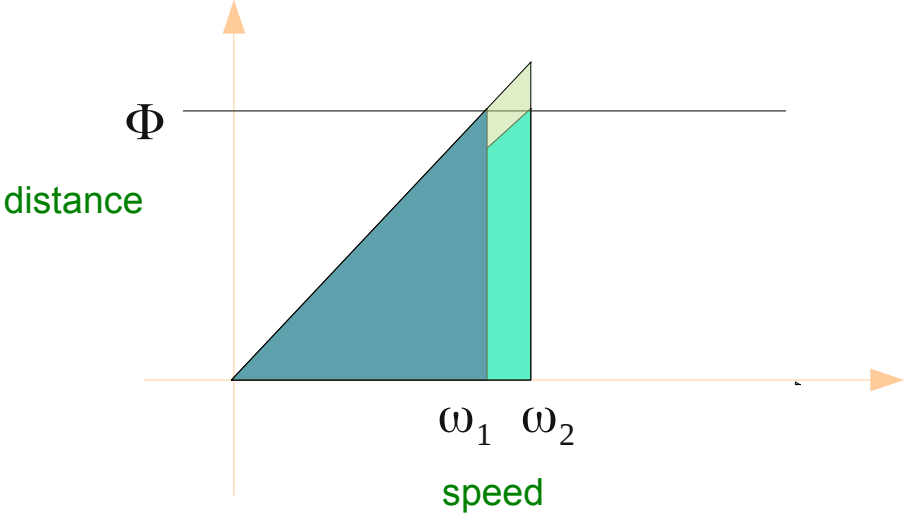
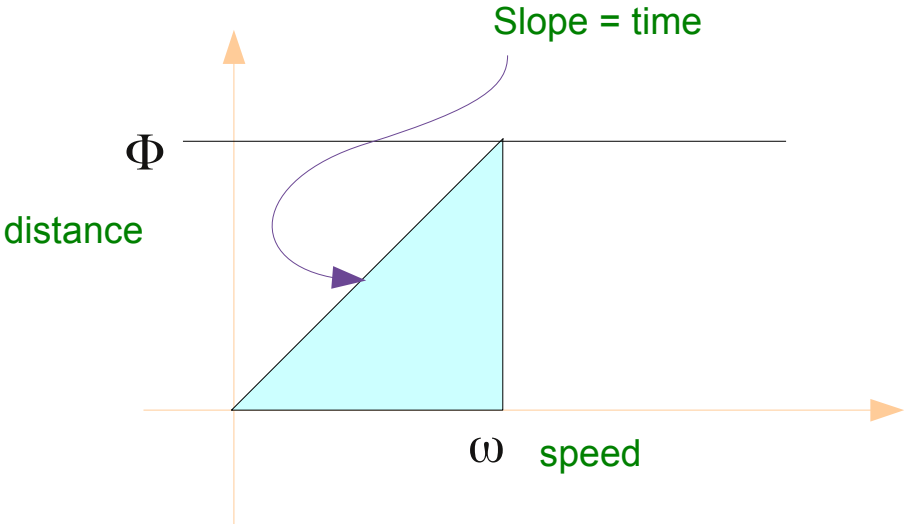
$$= \cos(2\pi * 0.1 * t) \cdot \cos(2\pi * 1.0 * t)$$

Slow
moving
envelop

Fast
moving
carrier



Angle and Angular Speed



References

- [1] <http://en.wikipedia.org/>
- [2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003
- [3] A “graphical interpretation” of the DFT and FFT, by Steve Mann