

# Propagating Wave (1A)

---

Copyright (c) 2011 Young W. Lim.

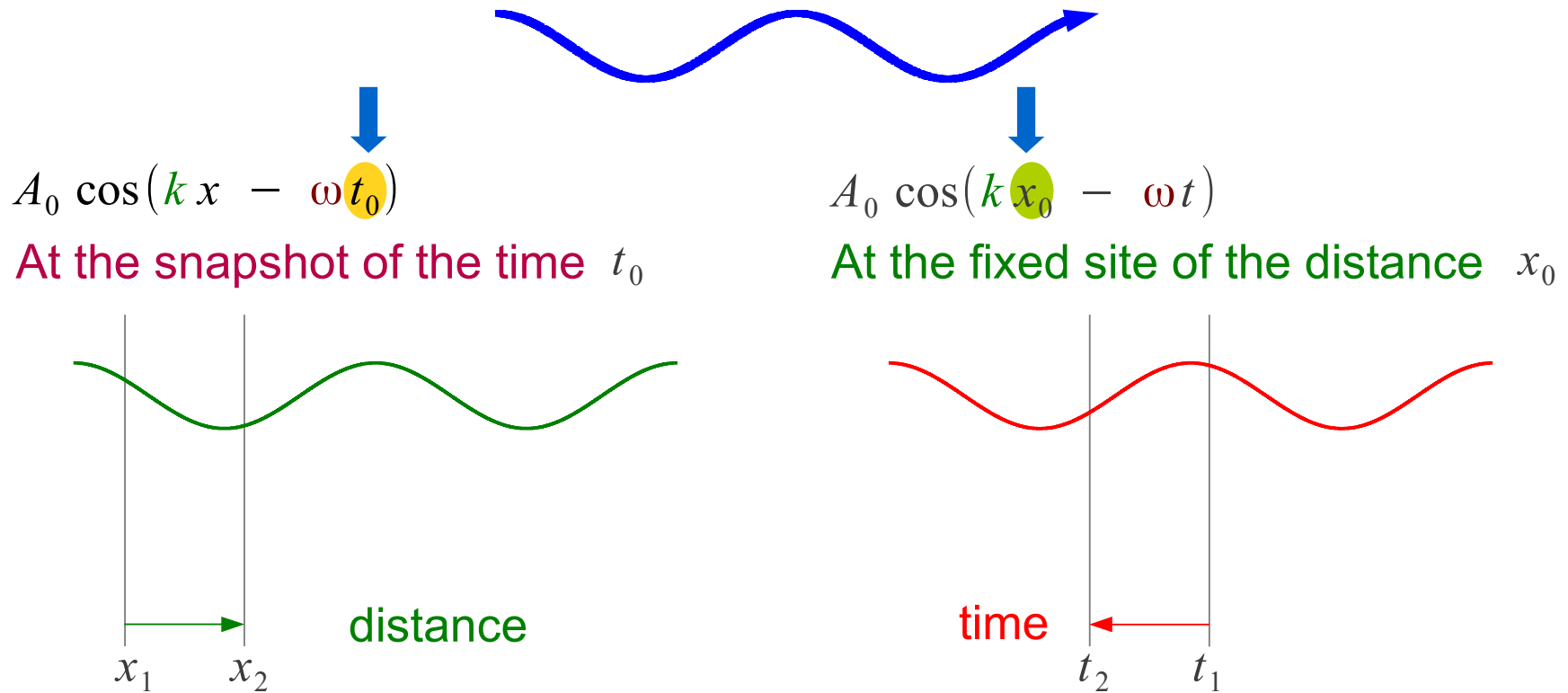
Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation License".

Please send corrections (or suggestions) to [youngwlim@hotmail.com](mailto:youngwlim@hotmail.com).

This document was produced by using OpenOffice and Octave.

# Wave Equation

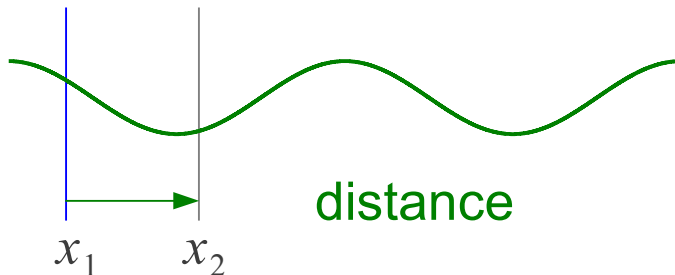
$$A(t, x) = A_0 \cos(kx - \omega t)$$



# Wavelength, Frequency

$$A_0 \cos(kx - \omega t_0)$$

At the snapshot of the time  $t_0$

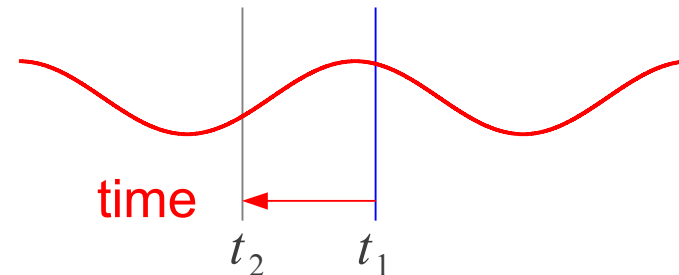


wavelength  $\lambda = \frac{2\pi}{k}$

wave number  $k = \frac{2\pi}{\lambda}$

$$A_0 \cos(kx_0 - \omega t)$$

At the fixed site of the distance  $x_0$



frequency  $f = \frac{\omega}{2\pi}$

period  $T = \frac{2\pi}{\omega}$

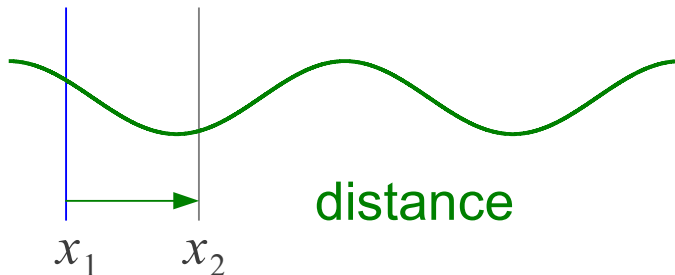
angular frequency  $\omega = 2\pi f$

angular frequency  $\omega = \frac{2\pi}{T}$

# Wave Number, Angular Frequency

$$A_0 \cos(kx - \omega t_0)$$

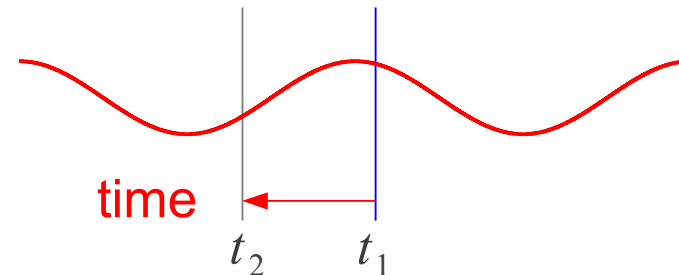
At the snapshot of the time  $t_0$



wave number  $k = \frac{2\pi}{\lambda}$   
*radians per unit distance*

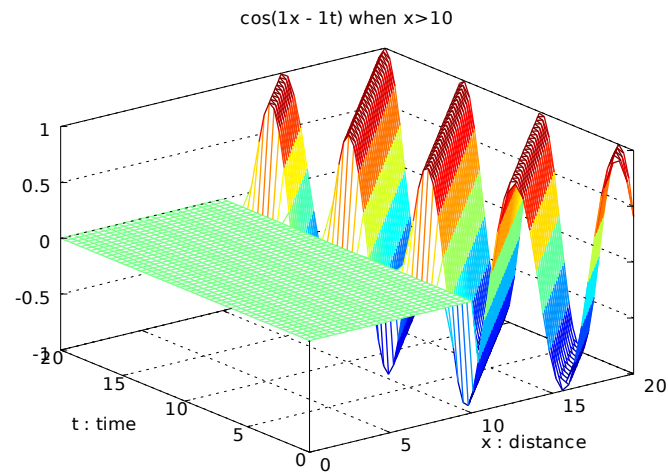
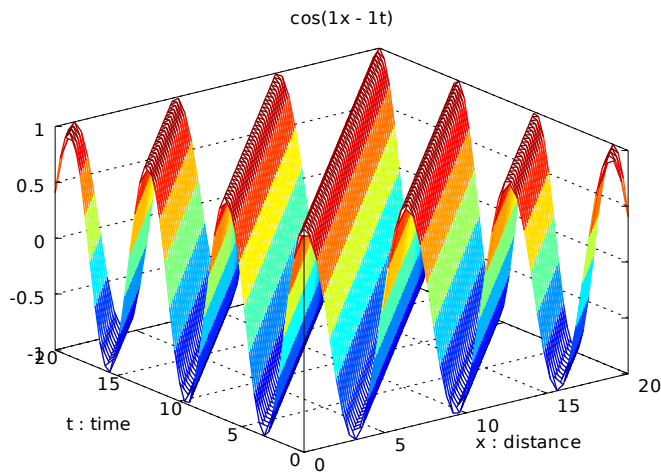
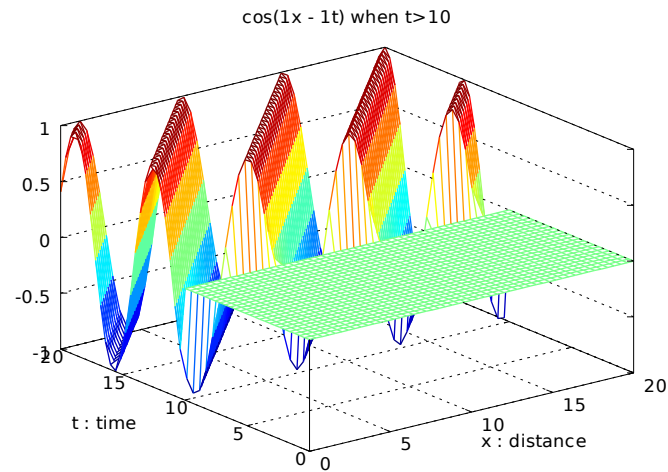
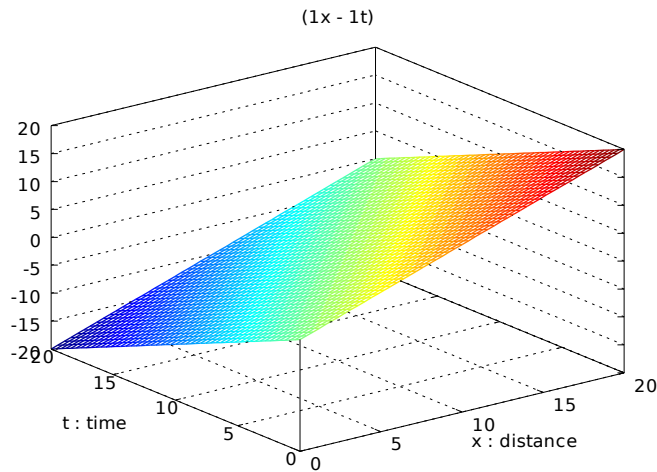
$$A_0 \cos(kx_0 - \omega t)$$

At the fixed site of the distance  $x_0$

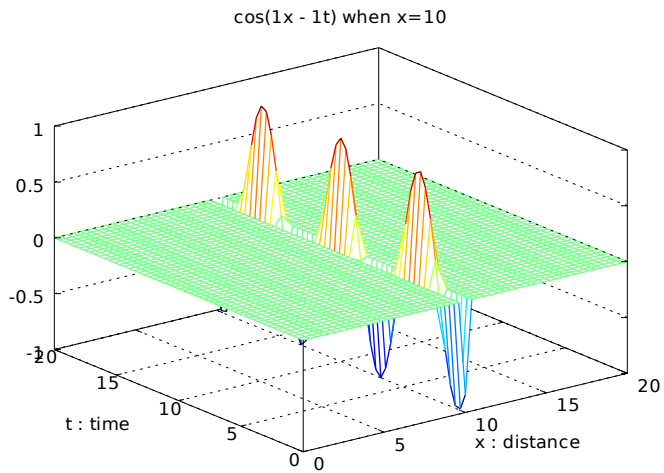
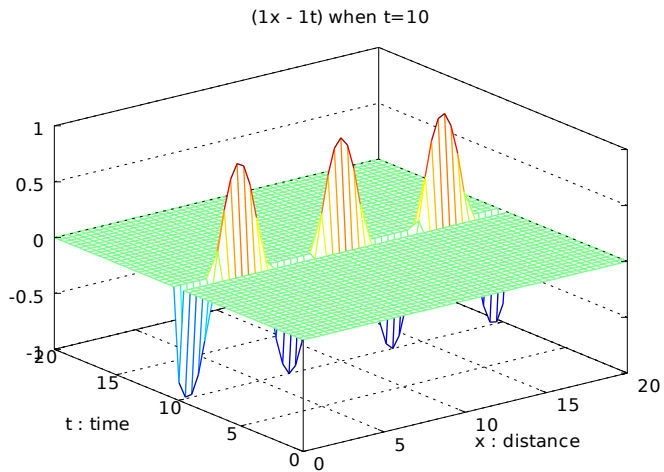


angular frequency  $\omega = \frac{2\pi}{T}$   
*radians per unit time*

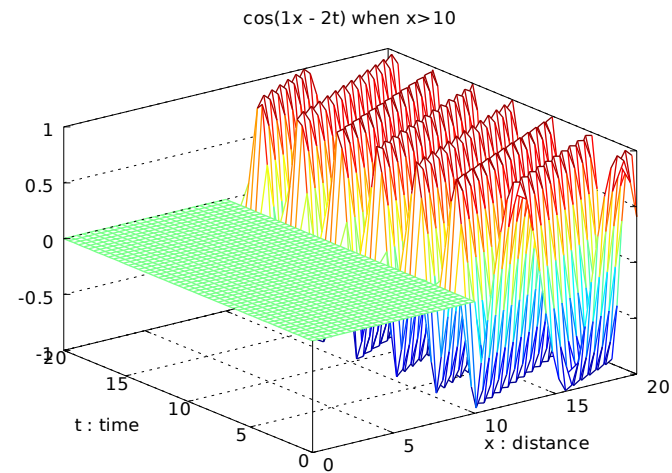
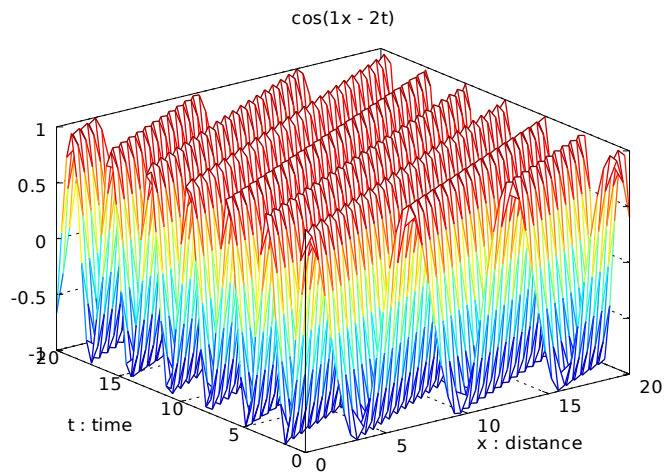
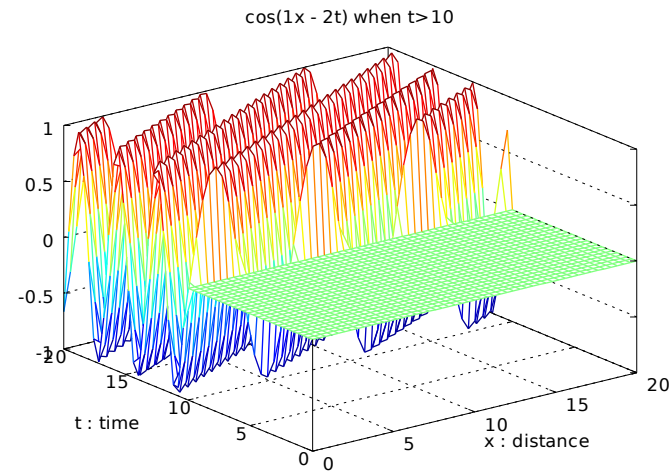
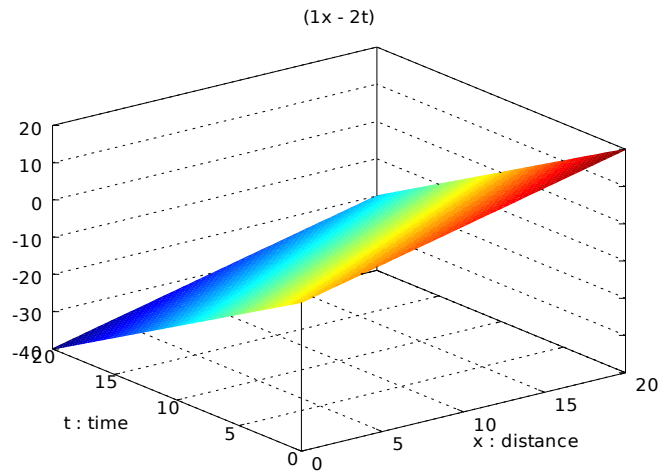
# COS(x-t) Example (1)



# COS(x-t) Example (2)

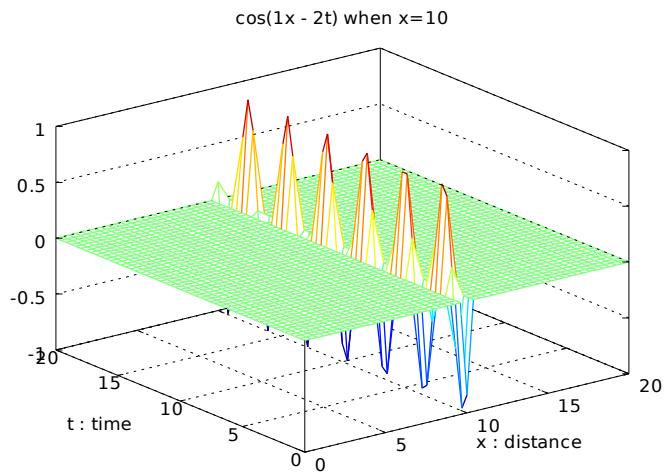
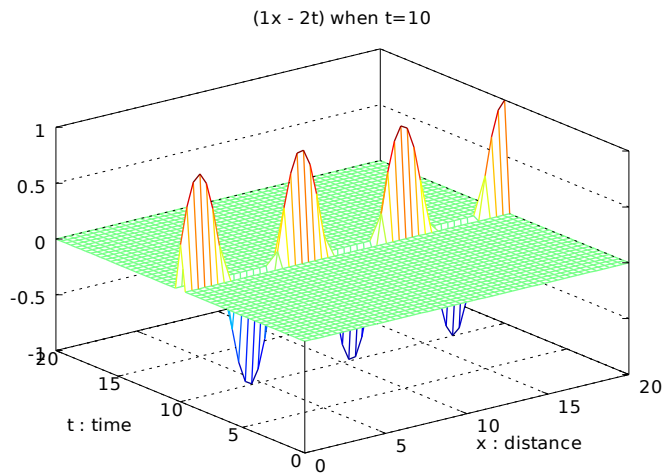


# COS(x-2t) Example (1)

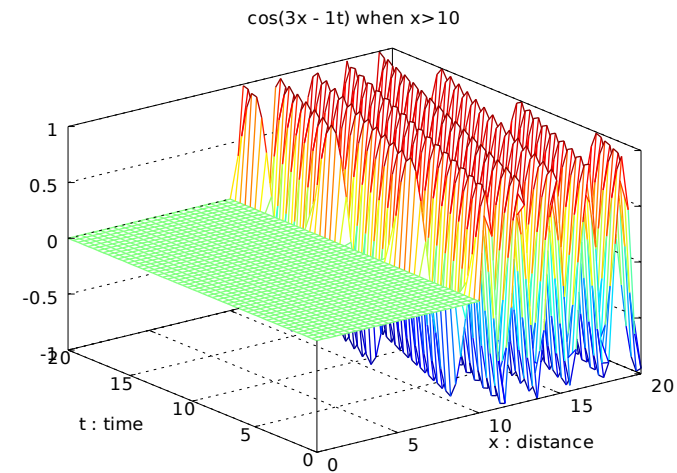
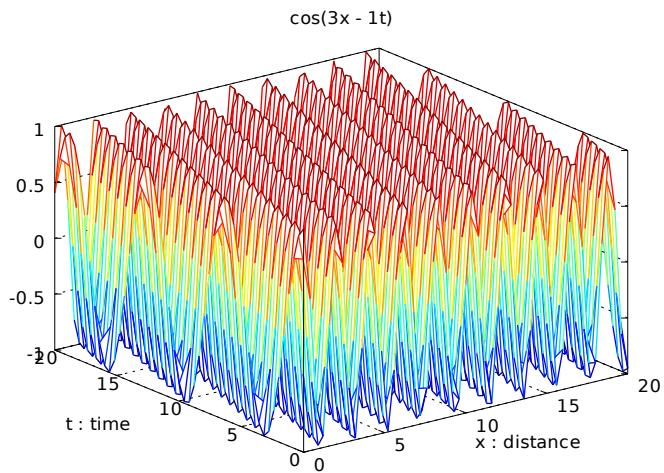
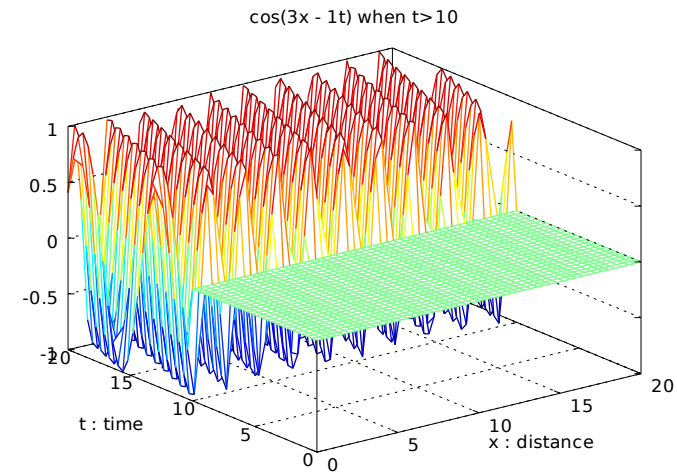
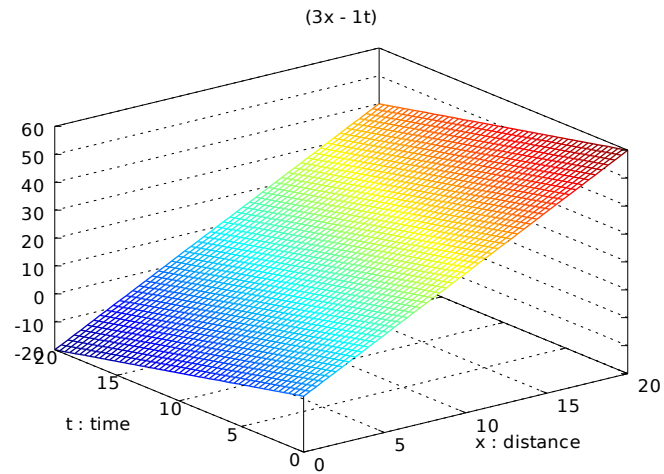




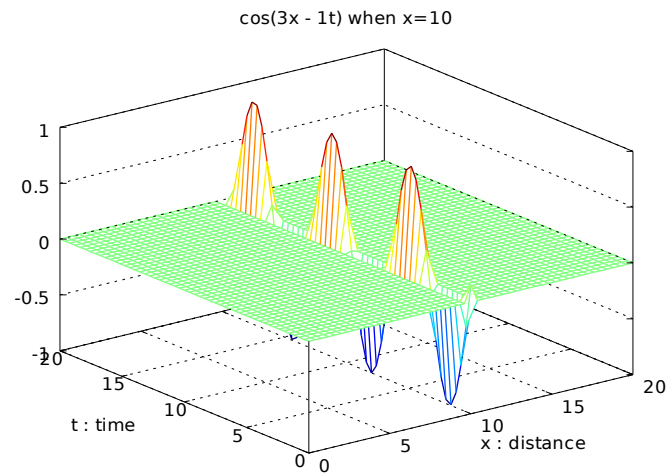
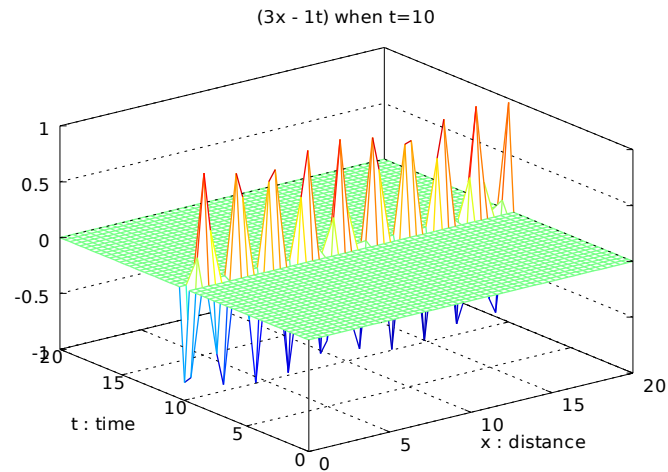
# COS(x-2t) Example (2)



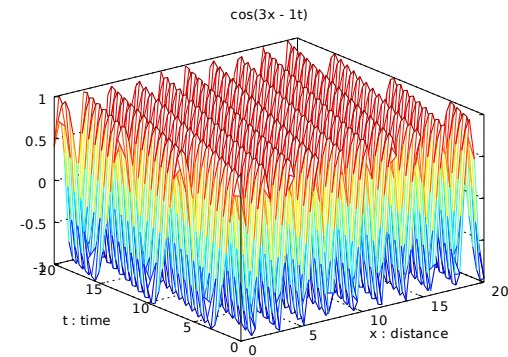
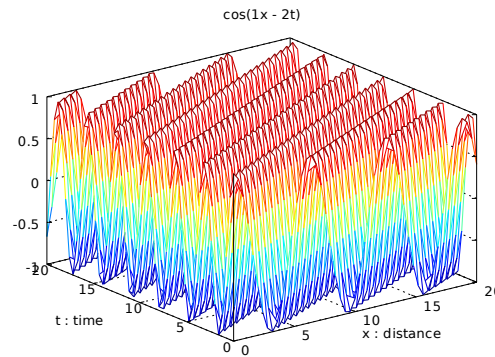
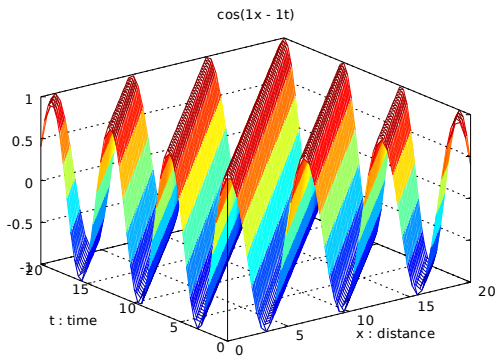
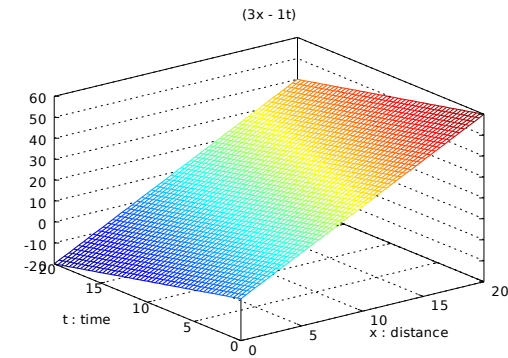
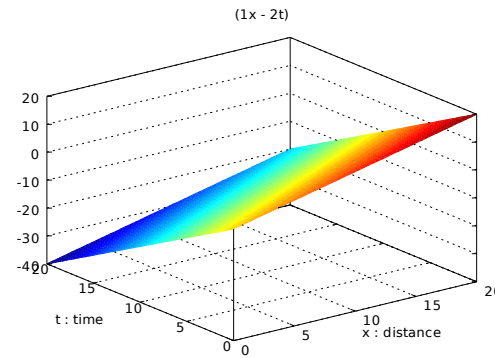
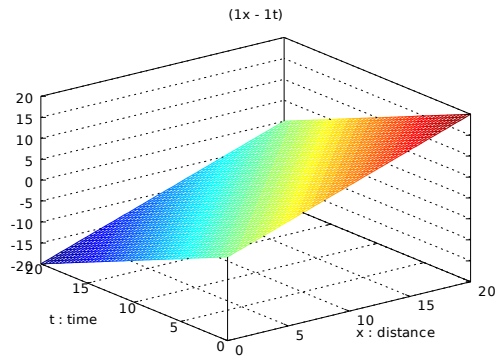
# COS(3x-t) Example (1)



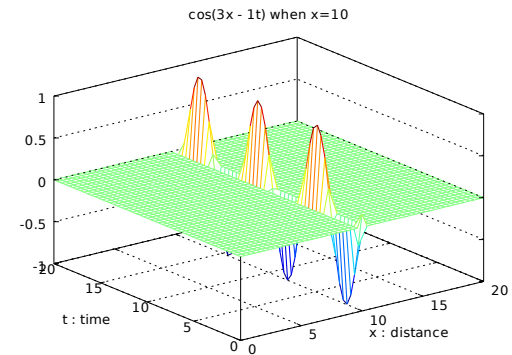
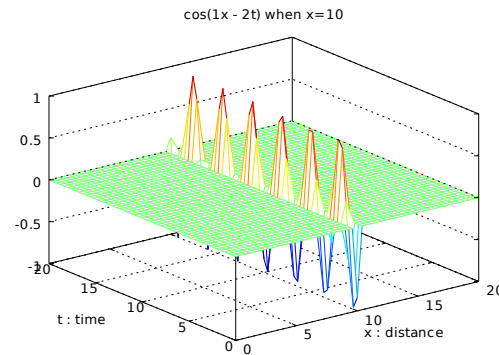
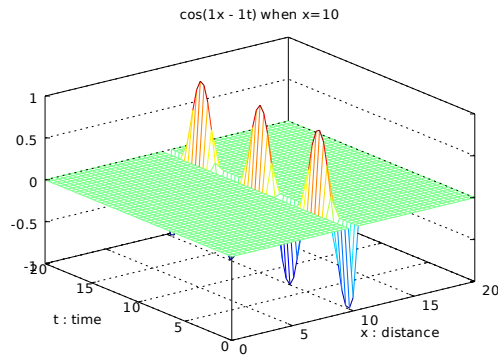
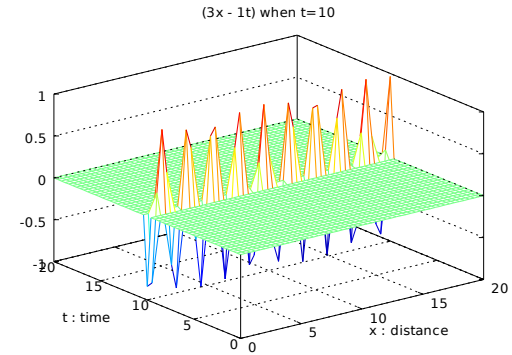
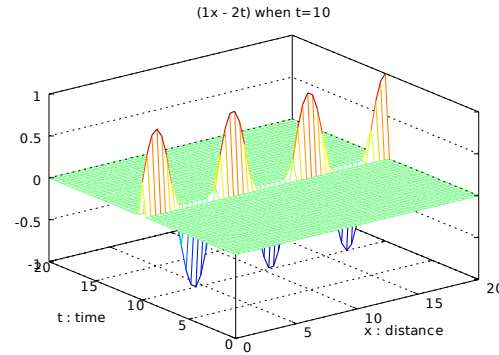
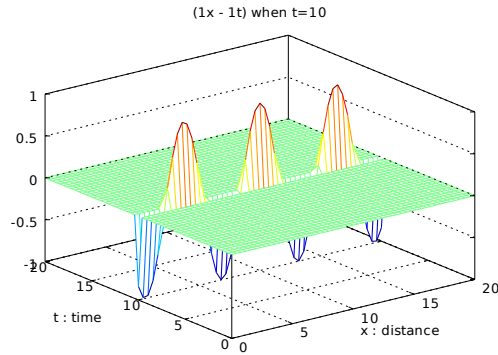
# COS(3x-t) Example (2)



# Comparison of Examples (1)



# Comparison of Examples (2)



## References

- [1] <http://en.wikipedia.org/>
- [2] J.H. McClellan, et al., Signal Processing First, Pearson Prentice Hall, 2003
- [3] <http://www.mathpages.com/>, Phase, Group, and Signal Velocity
- [4] R. Barlow, [www.hep.man.ac.uk/u/roger/PHYS10302/lecture15.pdf](http://www.hep.man.ac.uk/u/roger/PHYS10302/lecture15.pdf)
- [5] P. Hofmann, [www.philiphofmann.net/book\\_material/notes/groupphasevelocity.pdf](http://www.philiphofmann.net/book_material/notes/groupphasevelocity.pdf)