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program ana
  implicit none
  real :: string_length, time_end, x_step, t_step, phase_vel, lambda,
initial_pos, width, g
  common initial_pos, width, phase_vel, string_length
  integer :: nt, nx, i, j
  real, dimension(:,:), allocatable :: ya

  write(*, '("The following program is to calculate the position of a wave
generated by a stretched string is space-time)")')
  write(*, '("Using 1-D Wave Equation", /, 15X, "u_tt = phase_vel^2 u_xx",
/, /)')
  write(*, '("Enter the length of the string : ")', advance = "no")
  read *, string_length
  write(*, '("Enter the final time t : ")', advance = "no")
  read *, time_end
  write(*, '("Enter the step size in x : ")', advance = "no")
  read *, x_step
  write(*, '("Enter the step size in t : ")', advance = "no")
  read *, t_step
  write(*, '("Enter the constant A : ")', advance = "no")
  read *, phase_vel

  initial_pos = string_length/2
  width = string_length/5
  nt = time_end / t_step + 0.5
  nx = string_length / x_step + 0.5
  lambda = phase_vel*phase_vel*t_step*t_step/(x_step*x_step)
  allocate(ya(0:nx, 0:nt))
  open(19, file = "wavepulse_a.txt")
  !Analytical Methos
  do j = 0, nt
    write(19, '(a,f0.4)') "# Time: ", j*t_step
    do i = 0, nx
      ya(i,j) = g(i*x_step, j*t_step)
      write(19, '(F0.4, 2X, F0.4)') i*x_step, ya(i,j)
    end do
    write(19, '(/)')
  end do
  close(19)

  deallocate(ya)
end program ana

real function g(x,t)
  implicit none
  real :: x, t
  real :: x2
  real :: initial_pos, width, phase_vel, string_length
  common initial_pos, width, phase_vel, string_length
  g = 0
  ! This is the right moving pulse
  x2 = -x + t*phase_vel + initial_pos
  ! x2 needs to be in the range -string_length < x2 < +string_length
  ! to simulate an infinite train of pulses
  x2 = mod(x2 + string_length, 2*string_length) - string_length
  g = g + exp(-(x2/width)**2)
  ! And we subtract the left moving pulse
  x2 = x + t*phase_vel - initial_pos - string_length

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! x2 needs to be in the range -string_length < x2 < +string_length
! to simulate an infinite train of pulses
x2 = mod(x2 + string_length, 2*string_length) - string_length
g = g - exp(-(x2/width)**2)
return
end function g
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