

Wave Equation using Explicit Method

$$c^2 \frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$$

$$u_{i,2} = (1 - L)u_{i,1} + \frac{1}{2}L(u_{i+1,1} + u_{i-1,1}) + k g(x_i)$$

$$u_{i,j+1} = 2(1 - L)u_{i,j} + L(u_{i+1,j} + u_{i-1,j}) - u_{i,j-1}$$

$$L = \frac{k^2 c^2}{h^2}$$

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function u = wave_equation(x0, xn, t0, tn, h, k, c, f, g)
x = x0:h:xn;
t = t0:k:tn;

u = zeros(length(x), length(t));
u(:, 1) = f(x);

L = k^2 * c^2 / h^2;

for i = 2:length(x)-1
    u(i, 2) = (1-L)*u(i, 1) + (1/2)*L*(u(i+1, 1) + u(i-1, 1)) + k * g(x(i));
end

for j = 2:length(t)-1
    for i = 2:length(x)-1
        u(i, j+1) = 2*(1-L)*u(i, j) + L*(u(i+1, j) + u(i-1, j)) - u(i, j-1);
    end
end

figure
surf(t, x, u);
xlabel('x');
ylabel('t');
zlabel('u');

title('Wave Equation');

end
```