$$y_1^{n+1} = y_1^n + h y_2^n$$
$$y_2^{n+1} = y_2^n - h y_1^n + 2nh^2 + 2t^0 h \qquad (+)$$

In linear difference equations, as in linear differential equations, it is easy to show that the general solution is a particular solution of the nonhomogeneous equation plus any solution of the homogeneous equation. The proof is easy. Let $\vec{y}_p^{\,n}$ be a particular solution and $\vec{z}^{\,n}$ an arbitrary solution of the non-homogeneous eqn. Then

$$\vec{z}^{\,n} - \vec{y}_p^{\,n}$$

is a solution of the homogeneous equation, by linearity. So letting $\vec{y}_0^{\,n}$ be the homog. soln.,

$$\vec{z}^{\,n} = \vec{y}_p^{\,n} + \vec{y}_0^{\,n}.$$

OK. Now we can find a particular solution with ease (because I already know it)

$$\left.\begin{aligned} y_{1p}^n &= 2nh + 2t^0 \\ y_{2p}^n &= 2 \end{aligned}\right\} (*)$$

Use (+) to find $\vec{y}_p^{\,n+1}$

$$y_{1p}^{n+1} = 2nh + 2h + 2t^0 = 2(n+1)h + 2t^0$$
$$y_{2p}^{n+1} = 2 - \cancel{2nh^2} - \cancel{2t^0 h} + \cancel{2t^0 h} + \cancel{2nh^2}$$

which checks with (*) for $n \to n+1$.

Now we note that $y_1(t) = 2t$, $y_2(t) = 2$ is a particular solution to the exact differential equations also, and hence in $|y_{ex}(t) - y^n|$ the particular solutions drop out.