(4) Integrador simpléctico

El método de Verlet está dado por

$$x_{i+1} = x_i + v_i \Delta t + \frac{(\Delta t)^2}{2} a_i$$

$$v_{i+1} = v_i + \frac{\Delta t}{2}(a_{i+1} + a_i)$$

$$\frac{\partial x_{i+1}}{\partial x_i} = 1 + \frac{\Delta t^2}{2} a_i' \qquad \frac{\partial x_{i+1}}{\partial v_i} = \Delta t$$

$$\frac{\partial v_{i+1}}{\partial v_i} = 1 \qquad \frac{\partial v_{i+1}}{\partial x_i} = \frac{\Delta t}{2} a_i'$$

$$J = \left(1 + \frac{(\Delta t)^2}{2} a_i'\right) 1 - \left(\Delta t \frac{\Delta t}{2} a_i'\right) = 1$$