

Collision Detection

Collision probability matrix:

$$\begin{bmatrix} 0 & p_{12} & p_{13} & p_{14} & \cdots & p_{1n} \\ p_{21} & 0 & p_{23} & p_{24} & \cdots & p_{2n} \\ p_{31} & p_{32} & 0 & p_{34} & \cdots & p_{3n} \\ p_{41} & p_{42} & p_{43} & 0 & \cdots & p_{4n} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ p_{n1} & p_{n2} & p_{n3} & p_{n4} & \cdots & 0 \end{bmatrix}$$

$$\begin{bmatrix} x_i(t) \\ y_i(t) \\ z_i(t) \end{bmatrix} = \begin{bmatrix} x_i(0) \\ y_i(0) \\ z_i(0) \end{bmatrix} + t * \begin{bmatrix} v_{i,x}(0) \\ v_{i,y}(0) \\ v_{i,z}(0) \end{bmatrix}$$

$$d_{ij}(t) = \sqrt{(x(t)_i - x(t)_j)^2 + (y(t)_i - y(t)_j)^2 + (z(t)_i - z(t)_j)^2}$$

$$r = \begin{bmatrix} x_1(0) \\ y_1(0) \\ z_1(0) \\ v_{1,x}(0) \\ v_{1,y}(0) \\ v_{1,z}(0) \\ r_1 \\ \cdots \\ x_n(0) \\ y_n(0) \\ z_n(0) \\ v_{n,x}(0) \\ v_{n,y}(0) \\ v_{n,z}(0) \\ r_n \\ t \end{bmatrix}$$

$$p_{ij} = E\{C_{ij}\} = \sum_{k=1}^m \frac{\delta(C_{i,j})}{m}$$

$$r = \begin{bmatrix} x_i(0) \\ y_i(0) \\ z_i(0) \\ v_{i,x}(0) \\ v_{i,y}(0) \\ v_{i,z}(0) \\ r_i \\ r \end{bmatrix}$$

$$t = \frac{(P(0)-0)\cdot(P(0)+V(0)-P(0))}{|P(0)+V(0)-P(0)|^2} = \frac{P(0)\cdot V(0)}{|V(0)|^2}$$

$$d = \frac{\left| \left((0-P(0)) \times (0-(P(0)+V(0))) \right) \right|}{\left| (P(0)+V(0))-P(0) \right|} = \frac{\left| -P(0) \times (-P(0)-V(0)) \right|}{|V(0)|}$$

$$d = |P(0) + t * V(0)|$$