

Potential Dimensions

Let u_{rx} and u_{ry} be the pre-collisions velocities of the red ball along the Collision and Sweep Axes, respectively. Let v_{rx} and v_{ry} be the post-collisions velocities of the red ball along the Collision and Sweep Axes, respectively. Likewise, let u_{bx} , u_{by} , v_{bx} , and v_{by} be the four velocities for the blue ball. Then,

$$\text{verticality} = \tan^{-1} \left(\frac{|u_{ry} + u_{by}|}{.5 \times |u_{rx} + u_{bx} + v_{rx} + v_{bx}|} \right), \quad (\text{D1})$$

$$\text{overall speed} = \frac{1}{4} \left[\sqrt{u_{rx}^2 + u_{ry}^2} + \sqrt{u_{bx}^2 + u_{by}^2} + \sqrt{v_{rx}^2 + v_{ry}^2} + \sqrt{v_{bx}^2 + v_{by}^2} \right], \quad (\text{D2})$$

$$\text{entrance grouping} = \sqrt{(u_{rx} - u_{bx})^2 + (u_{ry} - u_{by})^2}, \quad (\text{D3})$$

$$\begin{aligned} \text{asymmetry} = & \text{sqrt} \left[\left(-\frac{u_{rx}}{\max(|u_{rx}|, |u_{bx}|, |v_{rx}|, |v_{bx}|)} - \frac{u_{bx}}{\max(|u_{rx}|, |u_{bx}|, |v_{rx}|, |v_{bx}|)} \right)^2 + \right. \\ & \left. \left(\frac{u_{ry}}{\max(|u_{ry}|, |u_{by}|, |v_{ry}|, |v_{by}|)} - \frac{u_{by}}{\max(|u_{ry}|, |u_{by}|, |v_{ry}|, |v_{by}|)} \right)^2 \right] + \\ & \text{sqrt} \left[\left(-\frac{v_{rx}}{\max(|u_{rx}|, |u_{bx}|, |v_{rx}|, |v_{bx}|)} - \frac{v_{bx}}{\max(|u_{rx}|, |u_{bx}|, |v_{rx}|, |v_{bx}|)} \right)^2 + \right. \\ & \left. \left(-\frac{v_{ry}}{\max(|u_{ry}|, |u_{by}|, |v_{ry}|, |v_{by}|)} + \frac{v_{by}}{\max(|u_{ry}|, |u_{by}|, |v_{ry}|, |v_{by}|)} \right)^2 \right] \end{aligned}, \quad (\text{D4})$$