Colisão elástica 2D: Coeficiente de Restituição $e_n = 1$

Caso $m_1 > m_2$ e $\vec{u}_o = 0$

$$\vec{v}_o = \frac{\{2,\ 0\}}{3};\ v_o = \sqrt{\vec{v}_o.\vec{v}_o}\ ;\ \vartheta_o = \text{ArcCos}\left[\frac{\vec{v}_o}{v_o}.\{1,\ 0\}\right];$$

$$m_1 = 1;\ m_2 = 0.5\ m_1;$$

$$\vec{u}_1 = \frac{(2\ m_1)\ v_o\ \text{Cos}[\theta]\ \vec{u}_\theta}{m_1 + m_2};\ \vec{u}_o = \{0,\ 0\};$$

$$\vec{u}_\theta = \frac{\vec{v}_o}{\sqrt{\vec{v}_o.\vec{v}_o}}.\begin{pmatrix} \text{Cos}[\theta] & \text{Sin}[\theta] \\ -\text{Sin}[\theta] & \text{Cos}[\theta] \end{pmatrix};$$

$$\vec{w}_\theta = \vec{u}_\theta.\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix};$$

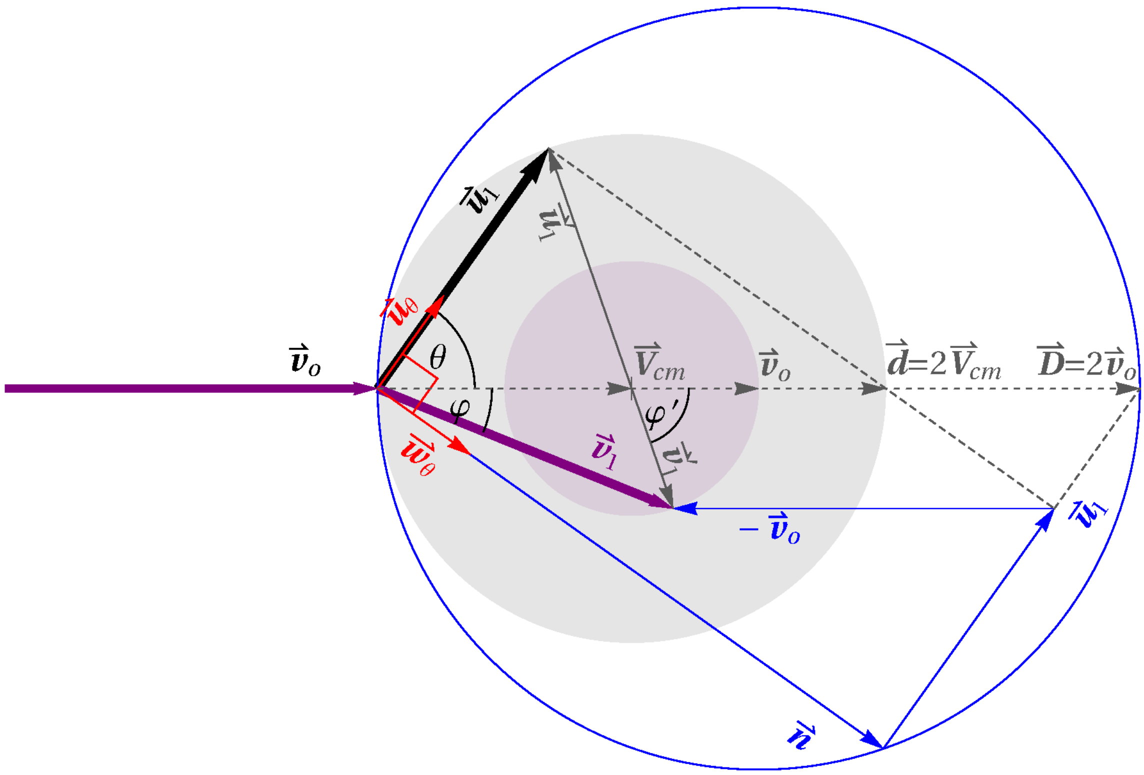
$$\vec{n} = 2\ v_o\ \text{Sin}[\theta]\ \vec{w}_\theta;$$

$$\vec{d} = \frac{(2\ m_1)\ \vec{v}_o}{m_1 + m_2};$$

$$\vec{v}_1 = \vec{u}_1 - \vec{v}_o + \vec{n};\ v_1 = \sqrt{\vec{v}_1.\vec{v}_1}\ ;$$

$$\vec{O} = \{0,\ 0\};$$

$$\vec{V}_{\text{cm}} = \frac{m_1\ \vec{v}_o + m_2\ \vec{u}_o}{m_1 + m_2};$$




```
Export["m1gm2.pdf", %];
```

Caso $m_2 > m_1$ e $\vec{u}_o = 0$

$\vec{v}_o = \frac{\{2,\ 0\}}{3}$; $v_o = \sqrt{\vec{v}_o.\vec{v}_o}$; $\vartheta_o = \text{ArcCos}\left[\frac{\vec{v}_o}{v_o}.\{1,\ 0\}\right]$;

$m_1 = 1$; $m_2 = 1.5\ m_1$;

$\vec{u}_1 = \frac{(2\ m_1)\ v_o\ \text{Cos}[\theta]\ \vec{u}_\theta}{m_1 + m_2}$; $\vec{u}_o = \{0,\ 0\}$;

$\vec{u}_\theta = \frac{\vec{v}_o}{\sqrt{\vec{v}_o.\vec{v}_o}}.\begin{pmatrix} \text{Cos}[\theta] & \text{Sin}[\theta] \\ -\text{Sin}[\theta] & \text{Cos}[\theta] \end{pmatrix}$;

$\vec{w}_\theta = \vec{u}_\theta.\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$;

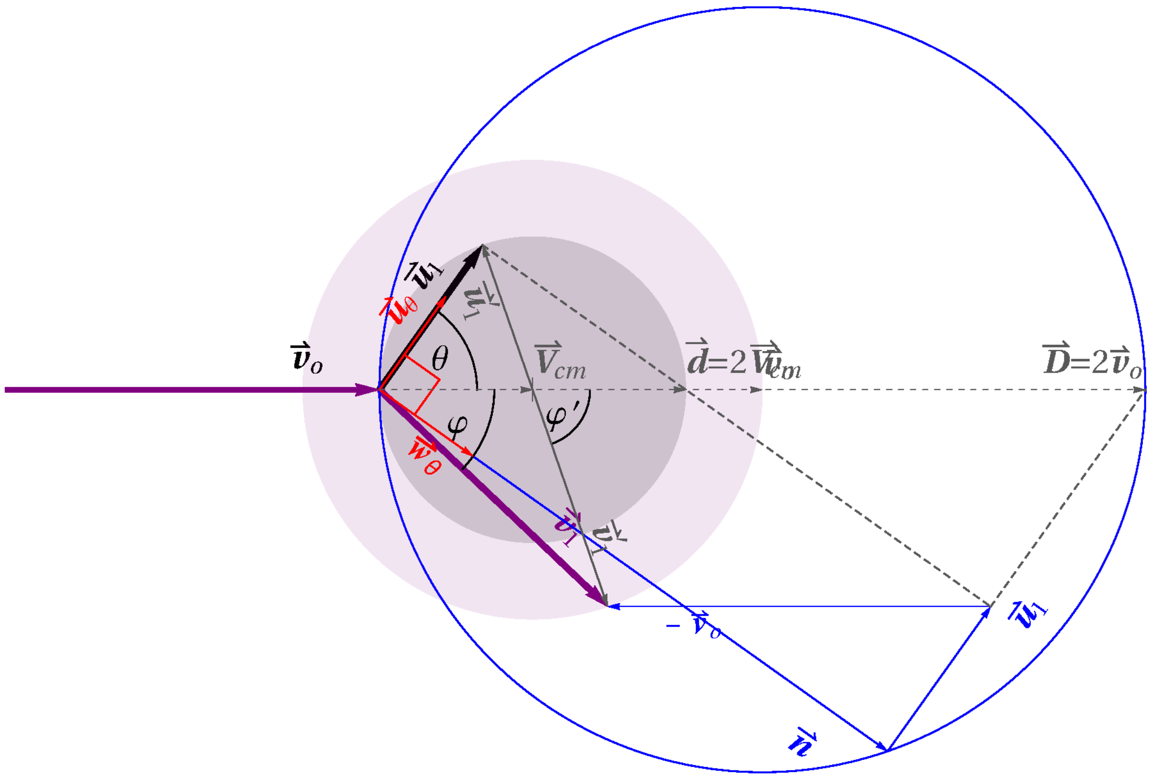
$\vec{n} = 2\ v_o\ \text{Sin}[\theta]\ \vec{w}_\theta$;

$\vec{d} = \frac{(2\ m_1)\ \vec{v}_o}{m_1 + m_2}$;

$\vec{v}_1 = \vec{u}_1 - \vec{v}_o + \vec{n}$; $v_1 = \sqrt{\vec{v}_1.\vec{v}_1}$;

$\vec{O} = \{0,\ 0\}$;

$\vec{V}_{\text{cm}} = \frac{m_1\ \vec{v}_o + m_2\ \vec{u}_o}{m_1 + m_2}$;



Export["m2gm1.pdf", %];

Caso $m_1 > m_2$ e $\vec{\boldsymbol{u}}_o \neq 0$

$$\mathbb{N} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix};$$

$\vec{\boldsymbol{u}}_o = \{4,\ 1\}\ 1.1;$

$\vec{\boldsymbol{v}}_o = \{1.26,\ 4\}\ .9;$

$\vec{\boldsymbol{e}}_x = \{1,\ 0\};$

$\vartheta_o = \text{ArcTan @@ } \left(\vec{v}_o - \vec{u}_o + \{.0000001,\ 0\}\right);$

$m_2 = 1.;$

$m_1 = 2.6;$

$$\vec{u}_1 = \vec{u}_o + \frac{2\, m_1}{(m_1 + m_2)} \sqrt{(\vec{v}_o - \vec{u}_o).(\vec{v}_o - \vec{u}_o)}\ \text{Cos}[\theta]\ \vec{u}_\theta;$$

$$\vec{u}_\theta = \frac{\vec{v}_o - \vec{u}_o}{\sqrt{(\vec{v}_o - \vec{u}_o).(\vec{v}_o - \vec{u}_o)}} . \begin{pmatrix} \text{Cos}[\theta] & \text{Sin}[\theta] \\ -\text{Sin}[\theta] & \text{Cos}[\theta] \end{pmatrix};$$

$\vec{w}_\theta = \vec{u}_\theta.\{\{0,\ -1\},\ \{1,\ 0\}\};$

$$\vec{n} = 2 \sqrt{(\vec{v}_o - \vec{u}_o).(\vec{v}_o - \vec{u}_o)}\ \text{Sin}[\theta]\ \vec{w}_\theta;$$

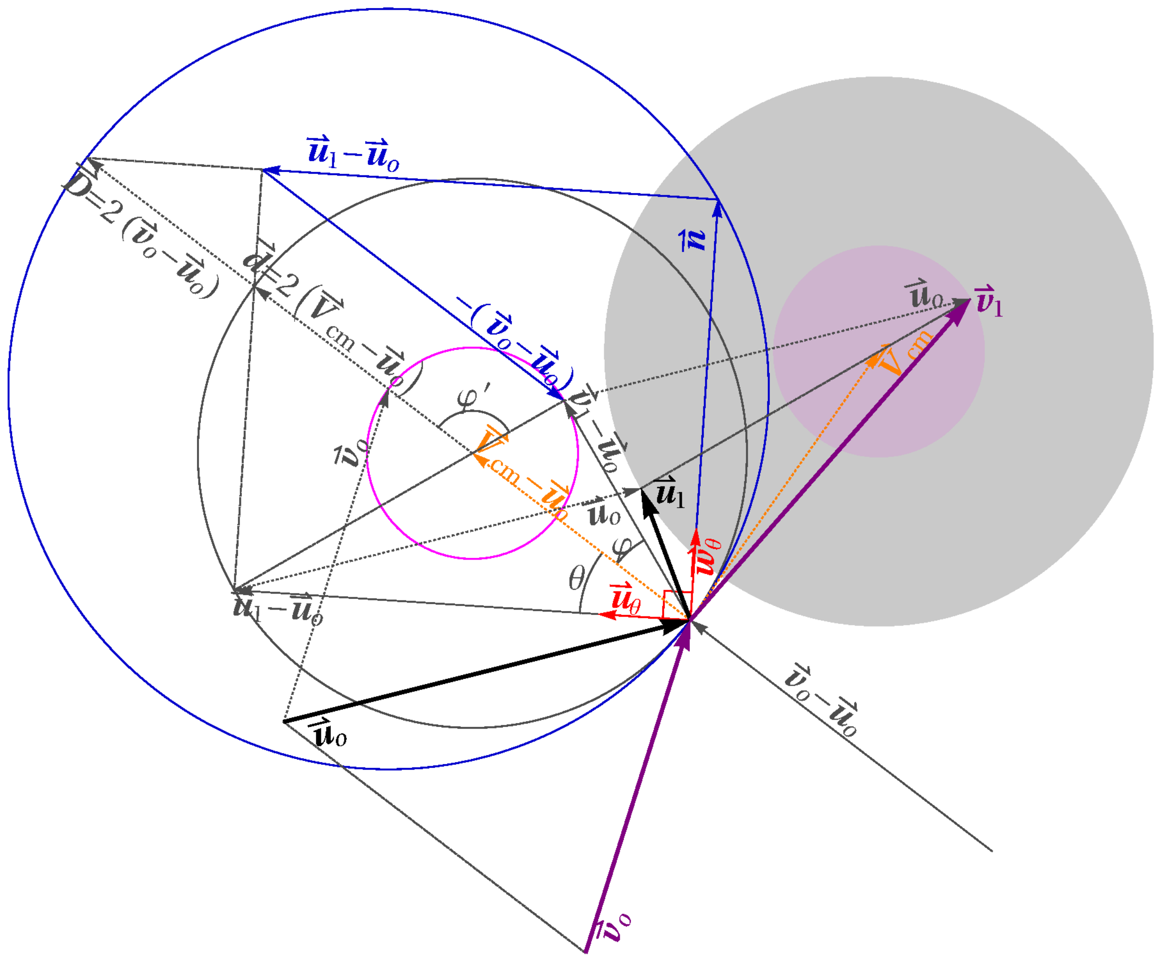
$$\vec{v}_1 = \vec{v}_o - \frac{m_2}{m_1} (\vec{u}_1 - \vec{u}_o);$$

(* $\vec{v}_1 = \vec{u}_1 - \vec{v}_o + \vec{n} + \vec{u}_o$; *)

$v_1 = \sqrt{\vec{v}_1.\vec{v}_1}\ ;$

$\vec{O} = \{0,\ 0\};$

$$\vec{V}_{\text{cm}} = \frac{m_1\, \vec{v}_o + m_2\, \vec{u}_o}{m_1 + m_2};$$



Export["m1gm2gen.pdf", %];

Caso $m_2 > m_1$ e $\vec{u}_o \neq 0$

$\mathbb{N} = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix};$

$\vec{u}_o = \{4,\ 1\}\ 1.1;$

$\vec{v}_o = \{1.26,\ 4\}\ .9;$

$\vec{e}_x = \{1,\ 0\};$

$\vartheta_o = \text{ArcTan}\ @@\left(\vec{v}_o - \vec{u}_o + \{.0000001,\ 0\}\right);$

$m_1 = 1.;$

$m_2 = 1.5;$

$$\vec{u}_1 = \vec{u}_o + \frac{2\, m_1}{(m_1 + m_2)} \sqrt{(\vec{v}_o - \vec{u}_o).(\vec{v}_o - \vec{u}_o)}\ \text{Cos}[\theta]\ \vec{u}_\theta;$$

$$\vec{u}_\theta = \frac{\vec{v}_o - \vec{u}_o}{\sqrt{(\vec{v}_o - \vec{u}_o).(\vec{v}_o - \vec{u}_o)}} . \begin{pmatrix} \text{Cos}[\theta] & \text{Sin}[\theta] \\ -\text{Sin}[\theta] & \text{Cos}[\theta] \end{pmatrix};$$

$$\vec{w}_\theta = \vec{u}_\theta . \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix};$$

$$\vec{n} = 2 \sqrt{(\vec{v}_o - \vec{u}_o).(\vec{v}_o - \vec{u}_o)}\ \text{Sin}[\theta]\ \vec{w}_\theta;$$

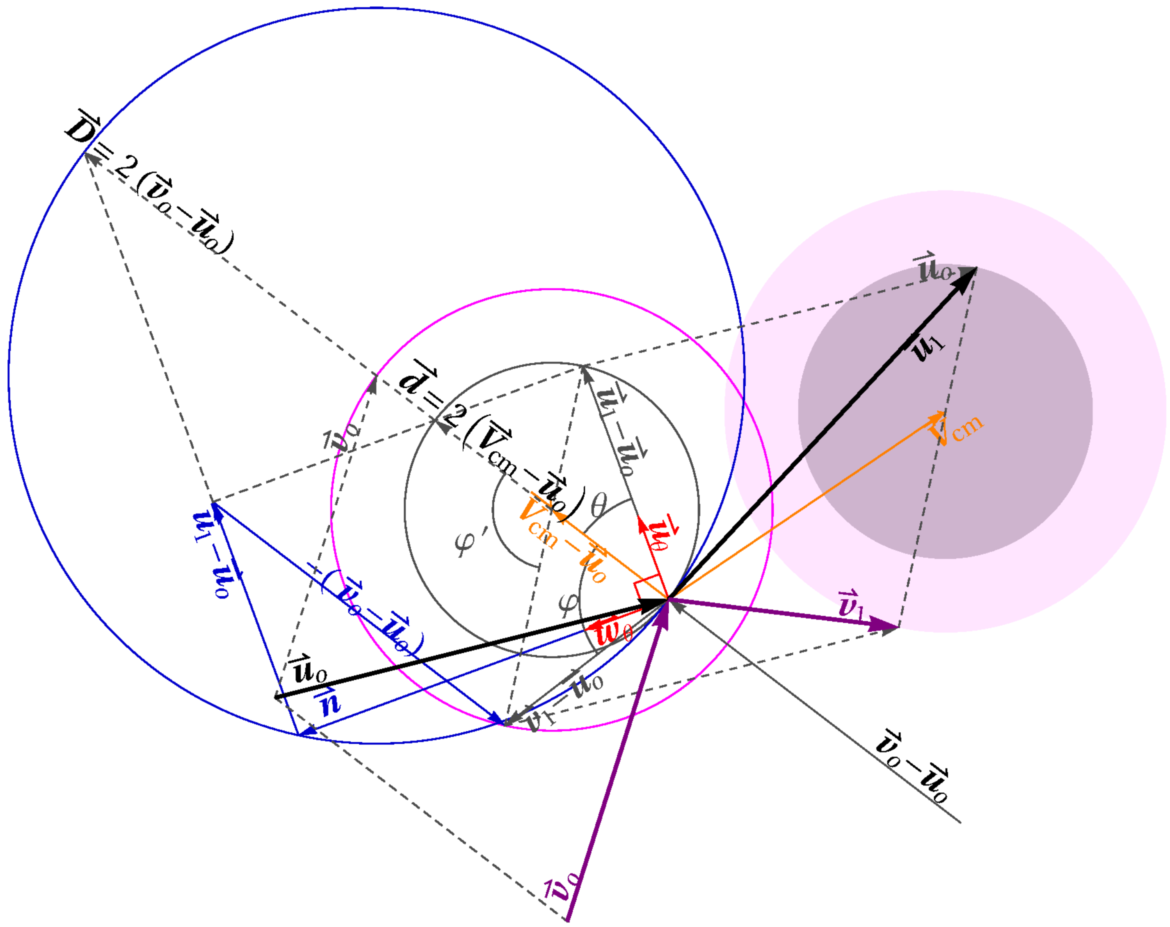
$$\vec{v}_1 = \vec{v}_o - \frac{m_2}{m_1} (\vec{u}_1 - \vec{u}_o);$$

$(* \ \vec{v}_1 = \vec{u}_1 - \vec{v}_o + \vec{n} + \vec{u}_o; \ *)$

$$v_1 = \sqrt{\vec{v}_1 . \vec{v}_1}\ ;$$

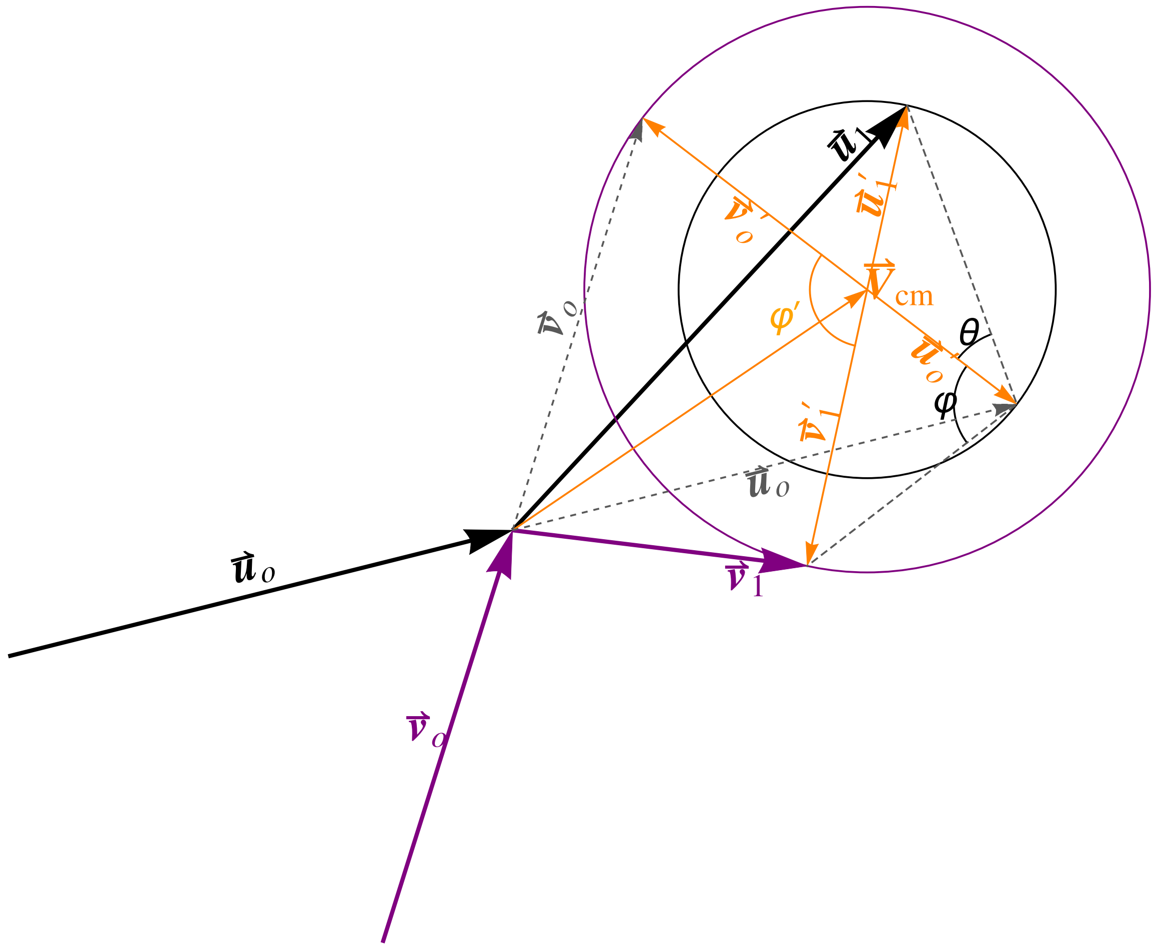
$\vec{O} = \{0,\ 0\};$

$$\vec{V}_{\text{cm}} = \frac{m_1\, \vec{v}_o + m_2\, \vec{u}_o}{m_1 + m_2};$$



Export["m2gm1gen.pdf", %];

Referencial do Centro de Massa



Export["cm_m2gm1gen.pdf", %];