Lecture 10

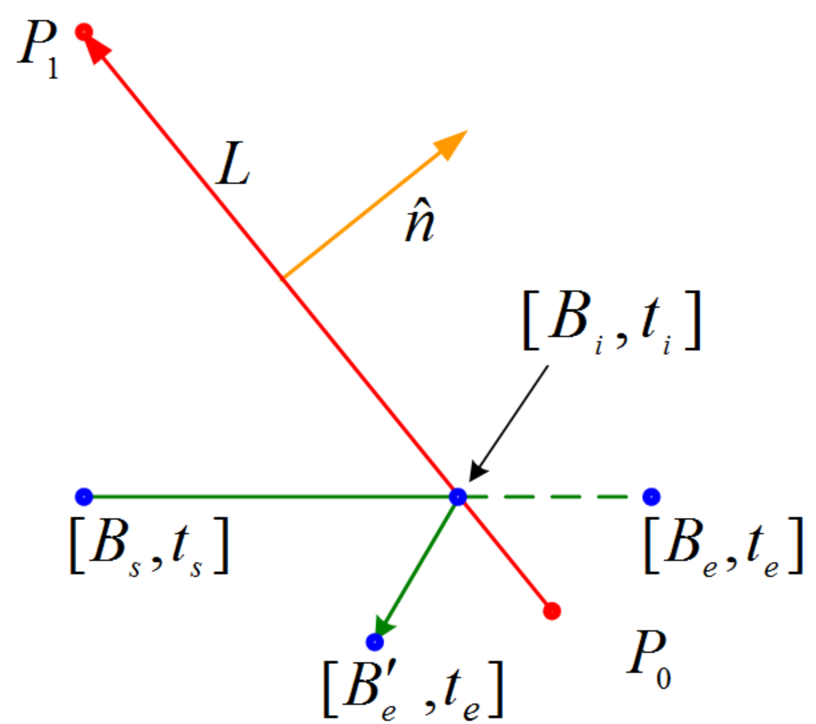
Antoine Abi Chakra

Overview

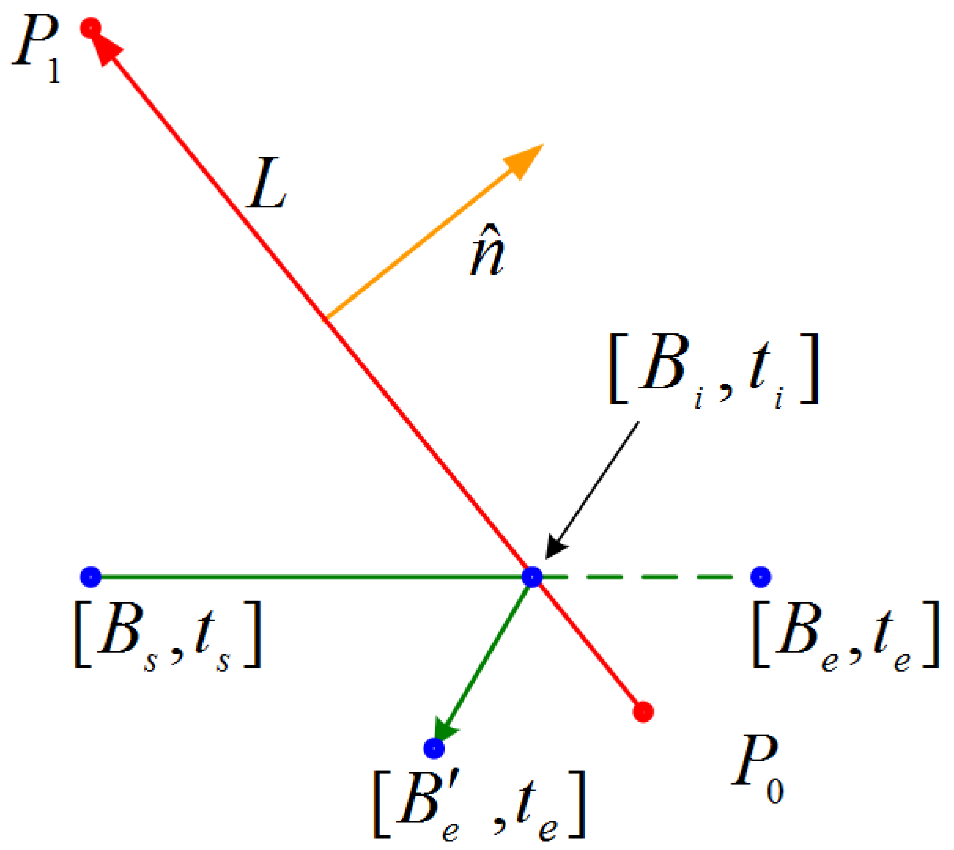
- Reflection
- Animated Circle to Line Segment

Position of Ball After Collision (1/8)

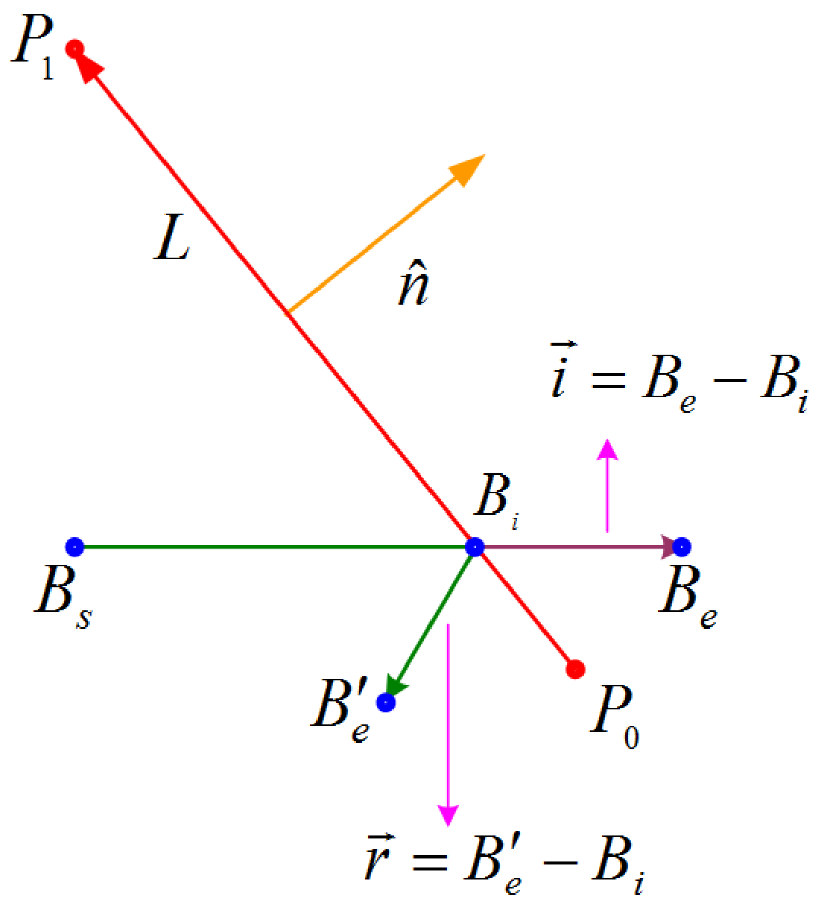
- Assuming elastic collision



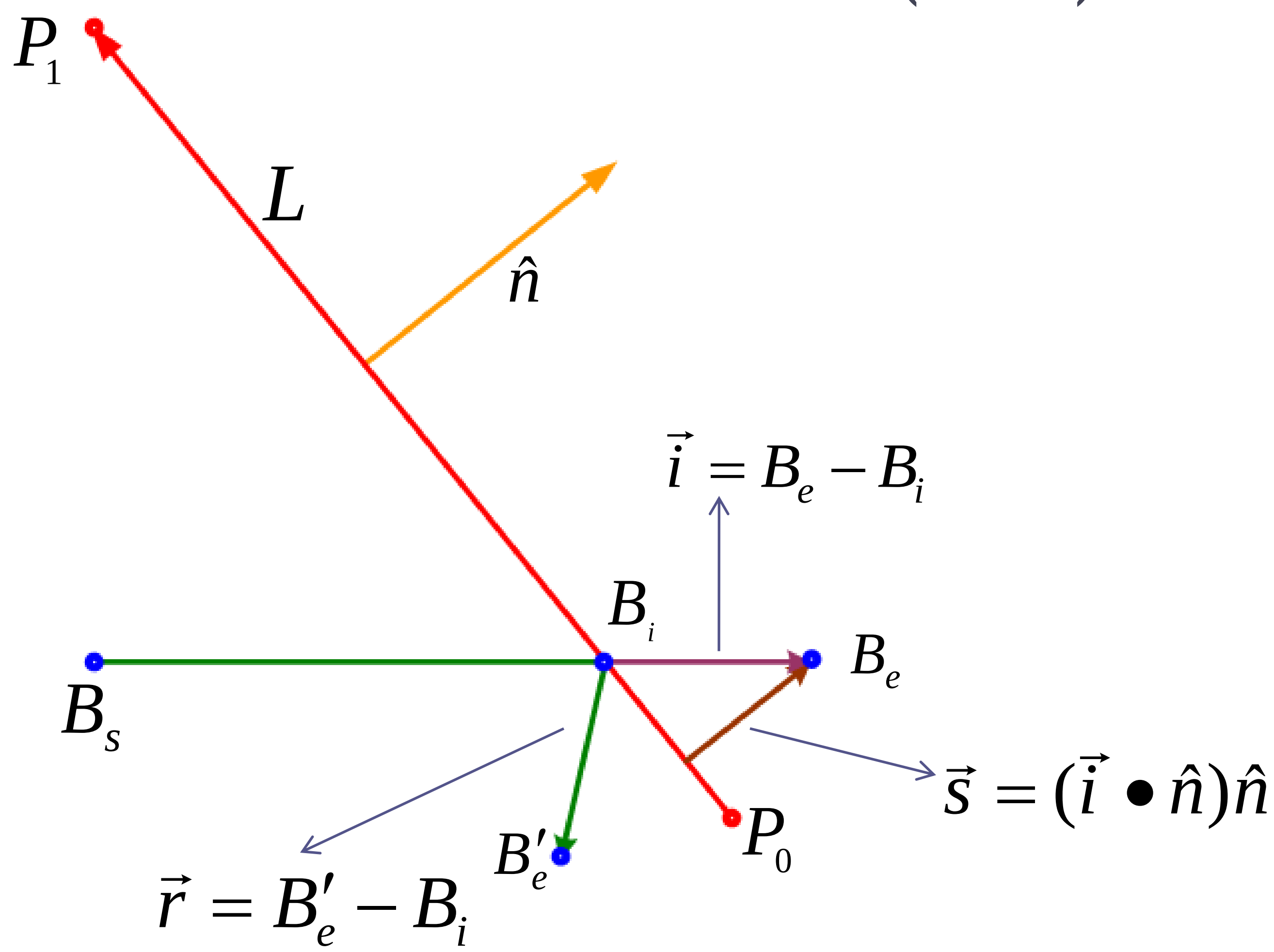
Position of Ball After Collision (2/8)



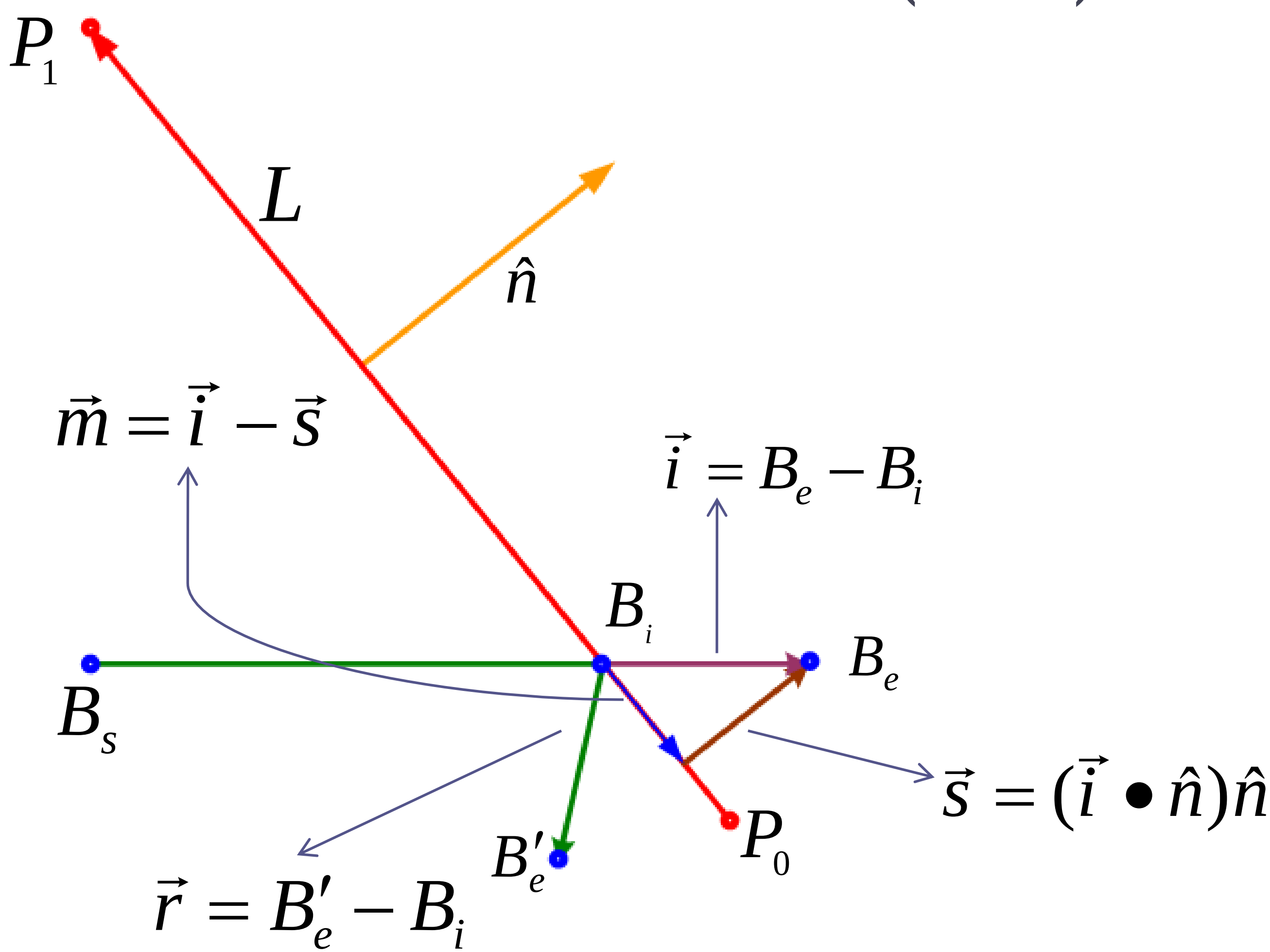
Position of Ball After Collision (3/8)



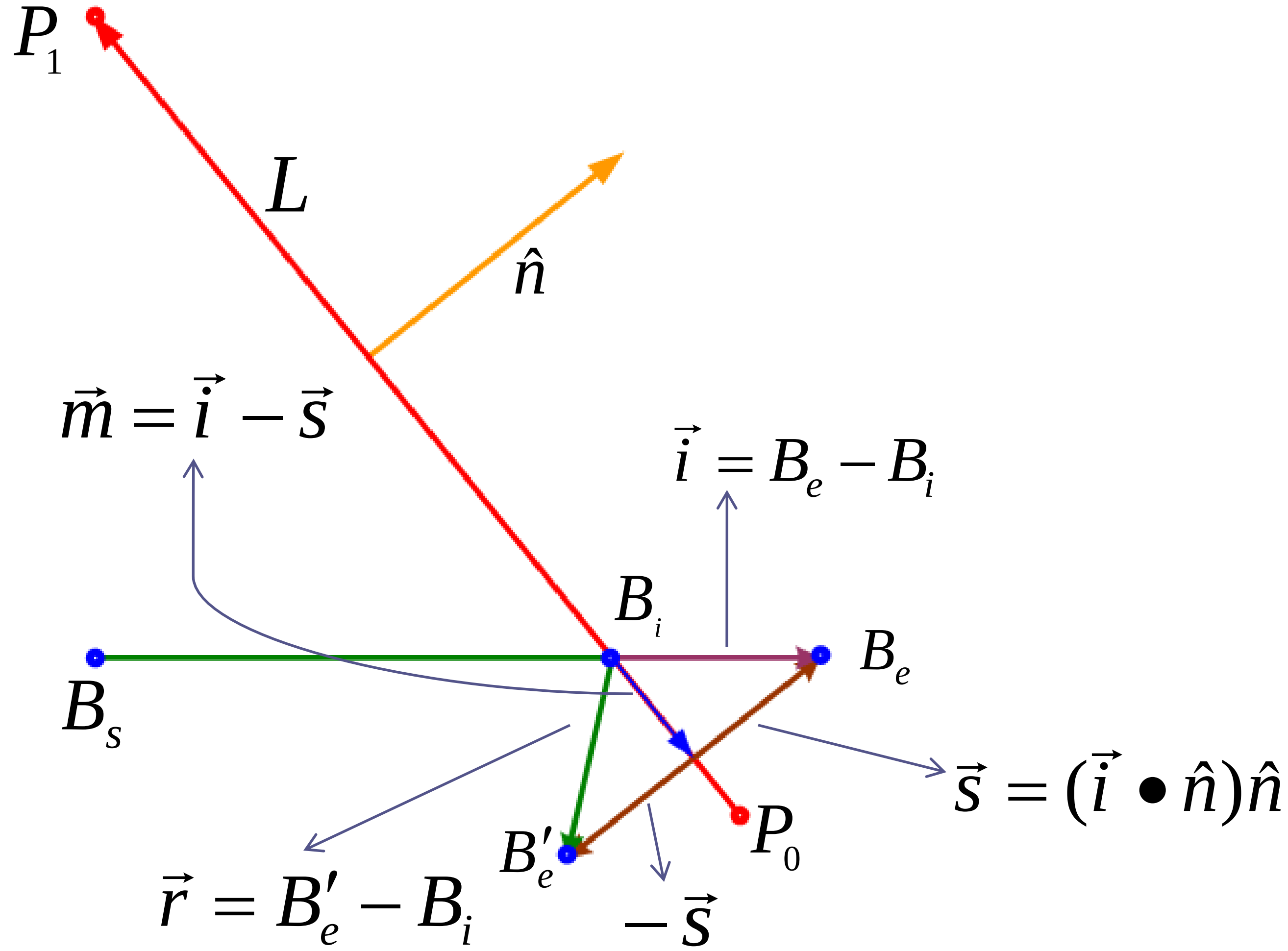
Position of Ball After Collision (4/8)



Position of Ball After Collision (5/8)



Position of Ball After Collision (6/8)



Position of Ball After Collision (7/8)

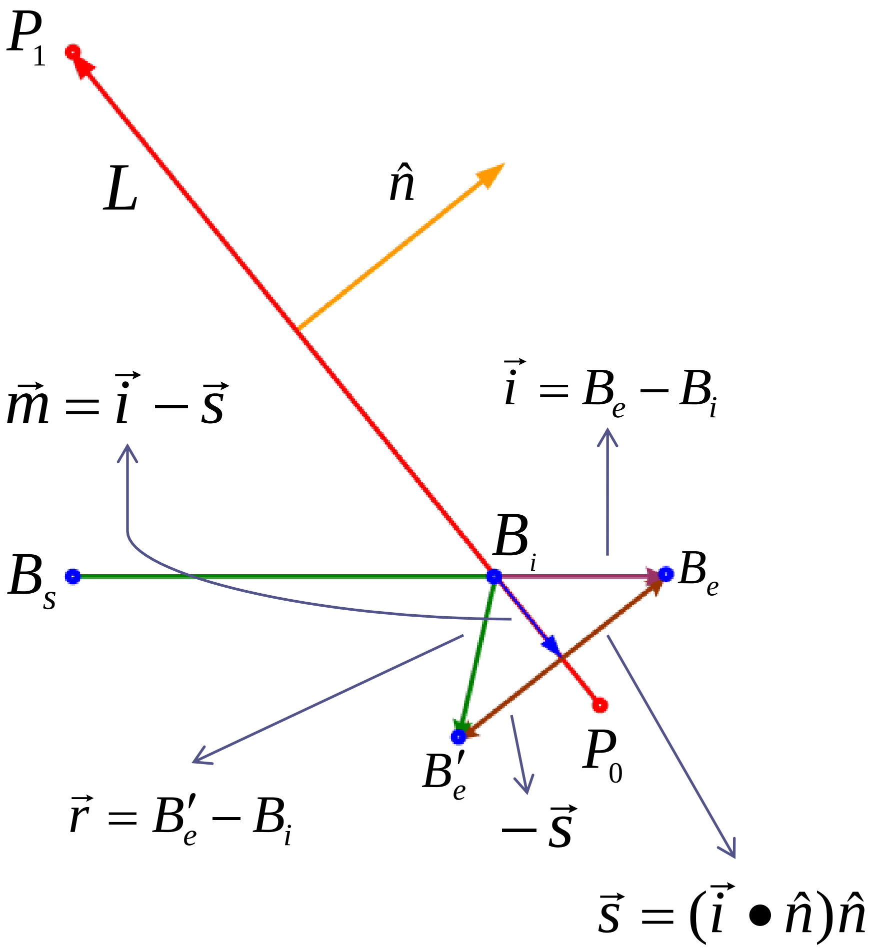
$$\vec{r} = \vec{m} - \vec{s}$$

$$\Rightarrow \vec{r} = \vec{i} - 2\vec{s}$$

$$\Rightarrow \vec{r} = \vec{i} - 2(\vec{i} \bullet \hat{n})\hat{n}$$

$$B'_e = B_i + \vec{r}$$

$$\Rightarrow B'_e = B_i + \vec{i} - 2(\vec{i} \bullet \hat{n})\hat{n}$$



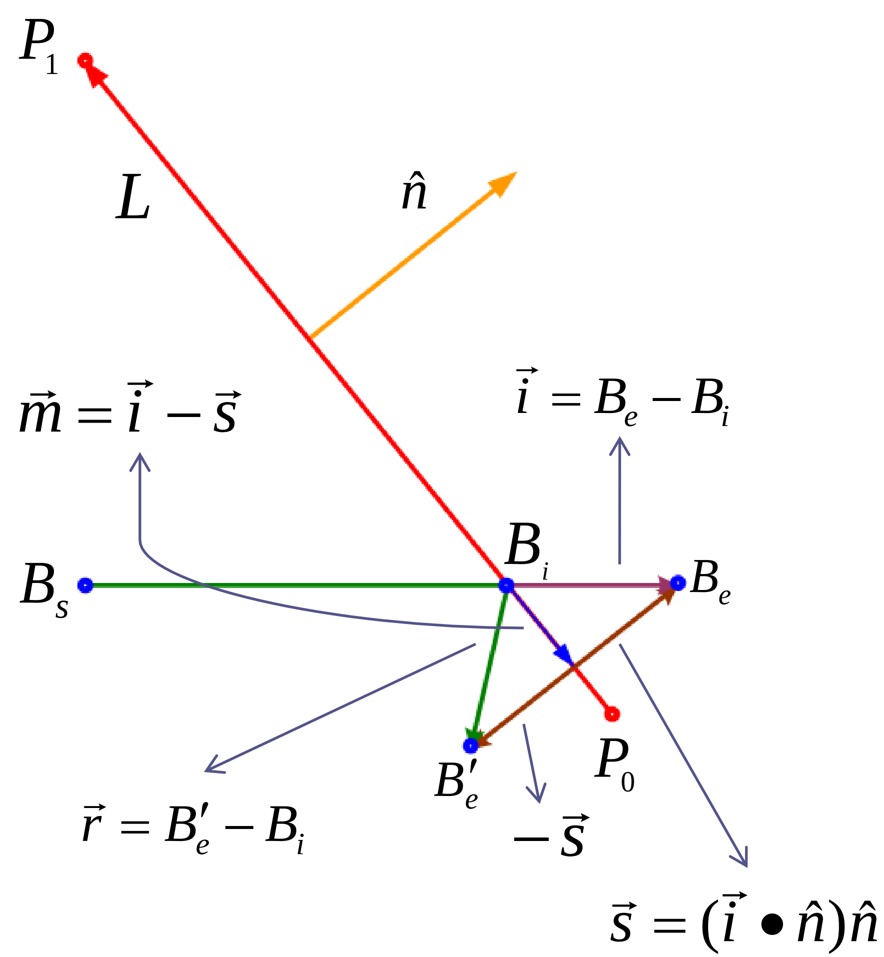
Position of Ball After Collision (8/8)

$$\vec{r} = \vec{m} - \vec{s}$$

$$\Rightarrow \vec{r} = \vec{i} - 2\vec{s}$$

$$\Rightarrow \vec{r} = \vec{i} - 2(\vec{i} \bullet \hat{n})\hat{n}$$

$$\hat{v} = \frac{\vec{r}}{\|\vec{r}\|}$$



Overview

- Reflection
- Animated Circle to Line Segment

Modeling Pinball as Circle

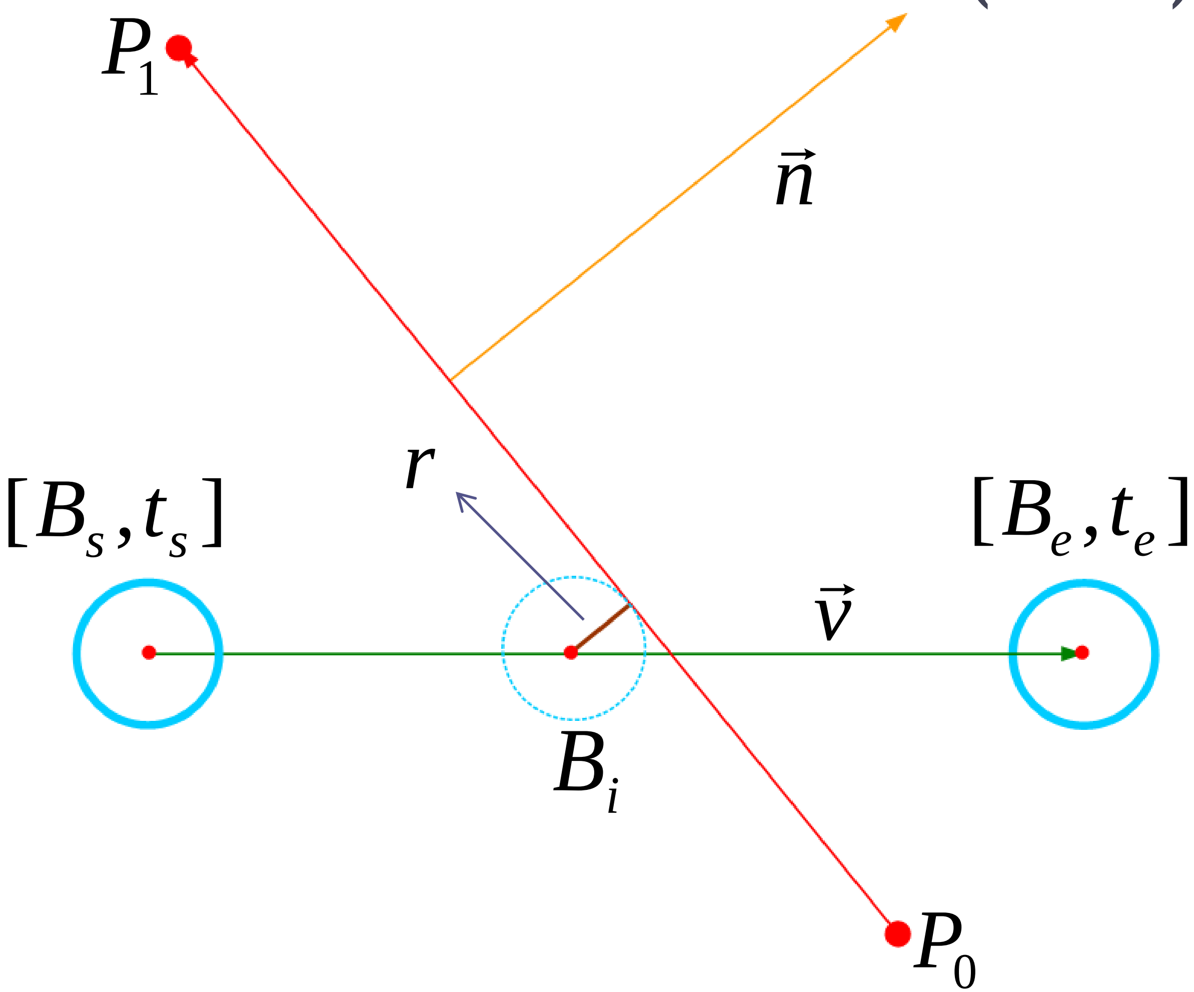
- Pinball modeled by a circle with center and radius r
- Located at center point B_s at top of frame
- Moving in direction given by normalized vector $\vec{v}$ and speed k units

$$B(t) = B_s + k\hat{v}t, t \in [0,1]$$

- Velocity per **<u>frame</u>** $\vec{v} = \overrightarrow{B_s B_e}$

$$\Rightarrow B(t) = B_s + \vec{v}t, t \in [0,1]$$

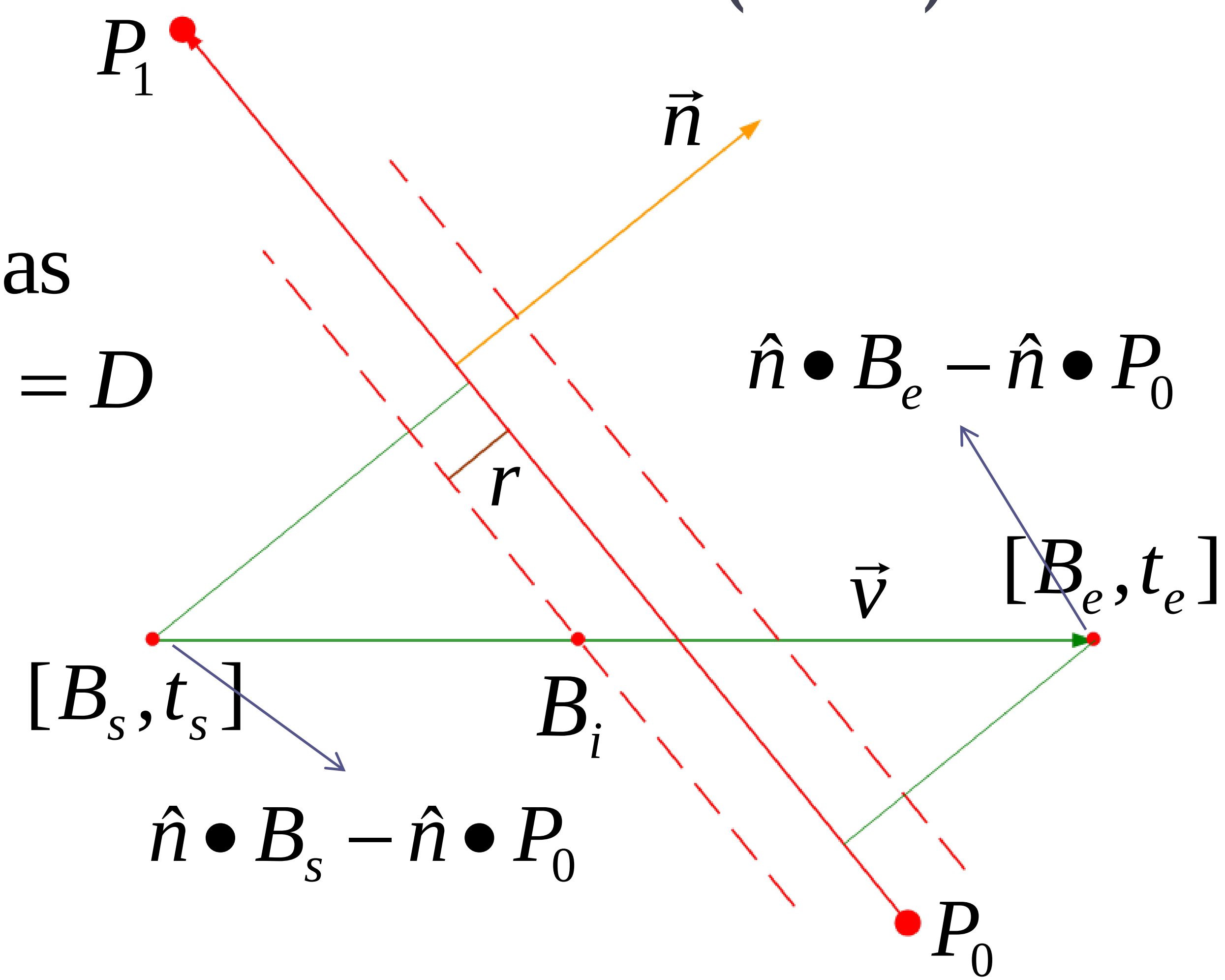
Pinball-Wall Intersection (1/3)



Pinball-Wall Intersection (2/3)

Wall modeled as

$$L : \vec{n} \bullet P - \vec{n} \bullet P_0 = D$$



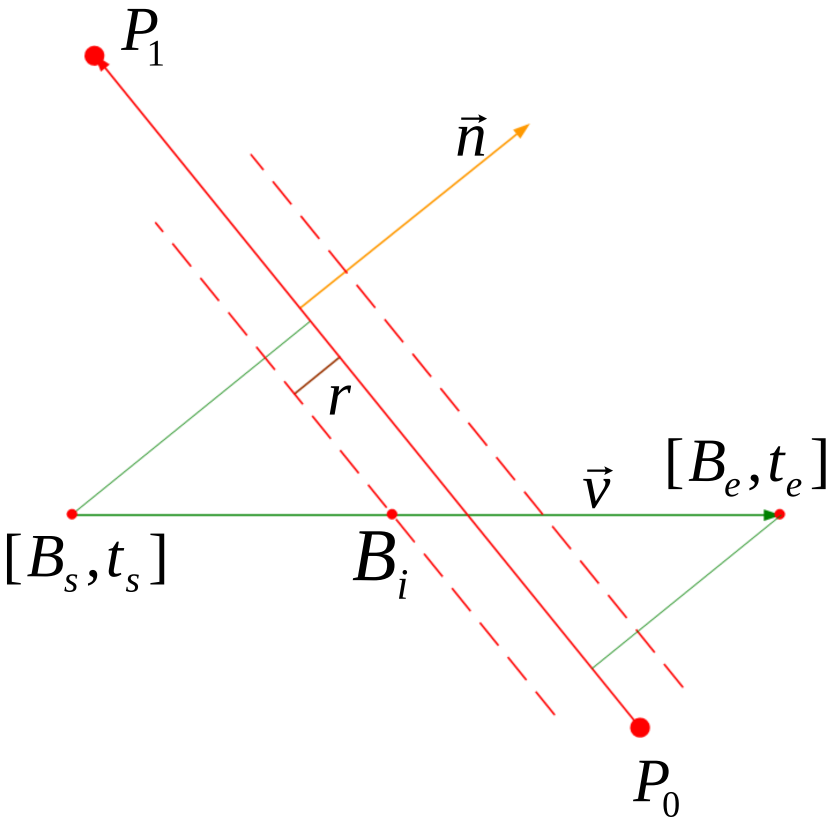
Pinball-Wall Intersection (3/3)

Pinball is inside at t_s and outside at t_e

$$t_i = \frac{\hat{n} \bullet P_0 - \hat{n} \bullet B_s + D}{\hat{n} \bullet \vec{v}}$$

where $t_i \in [0,1]$

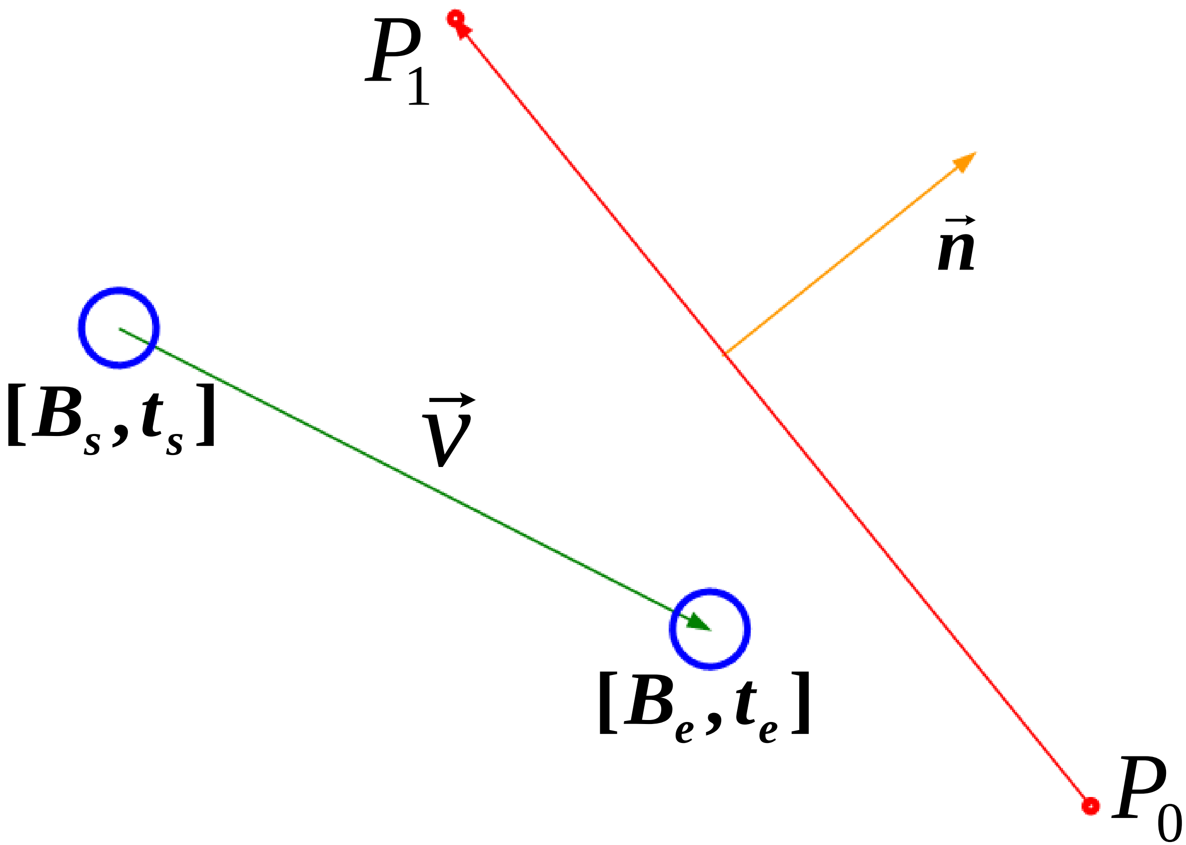
$$B_i = B_s + \vec{v}\left(\frac{\hat{n} \bullet P_0 - \hat{n} \bullet B_s + D}{\hat{n} \bullet \vec{v}}\right)$$



Note: D = -r when B_s is inside
D = r when B_s is outside

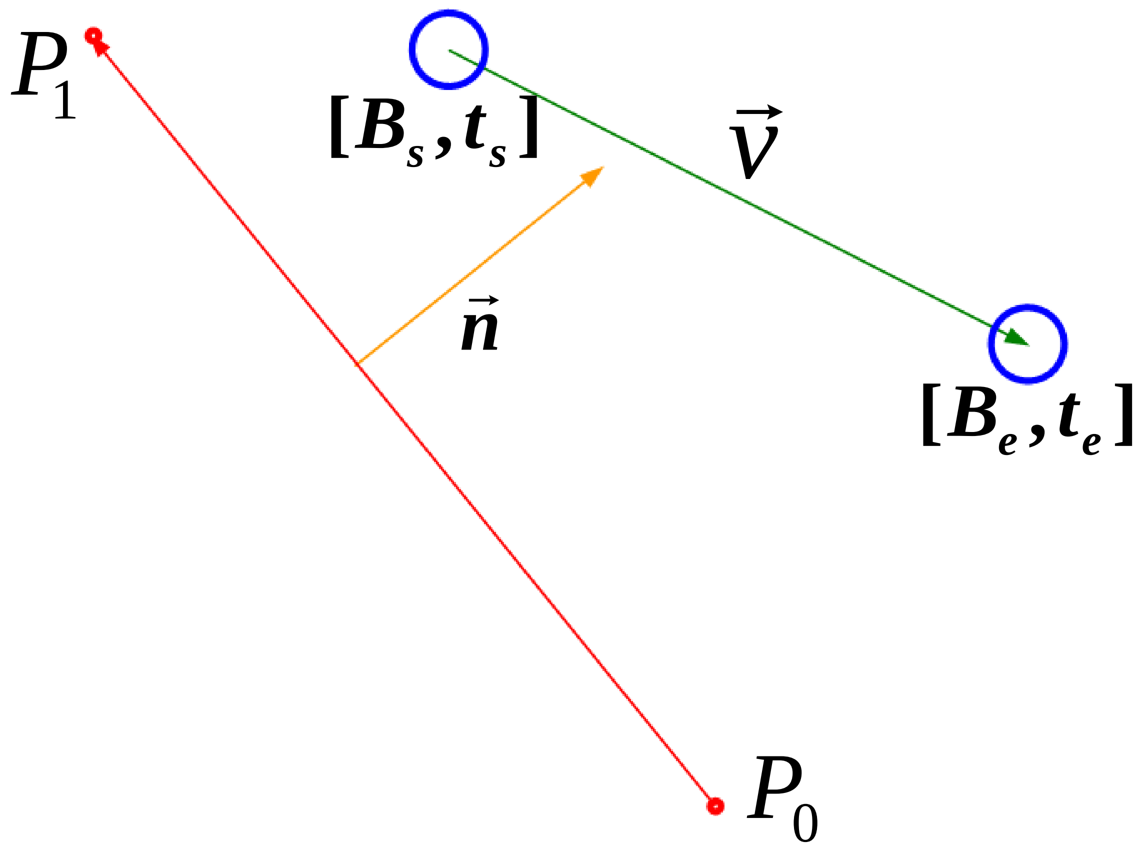
Test for Non-Collision (1/4)

$$(\vec{n} \bullet B_s - \vec{n} \bullet P_0 < -r) \&\& (\vec{n} \bullet B_e - \vec{n} \bullet P_0 < -r)$$



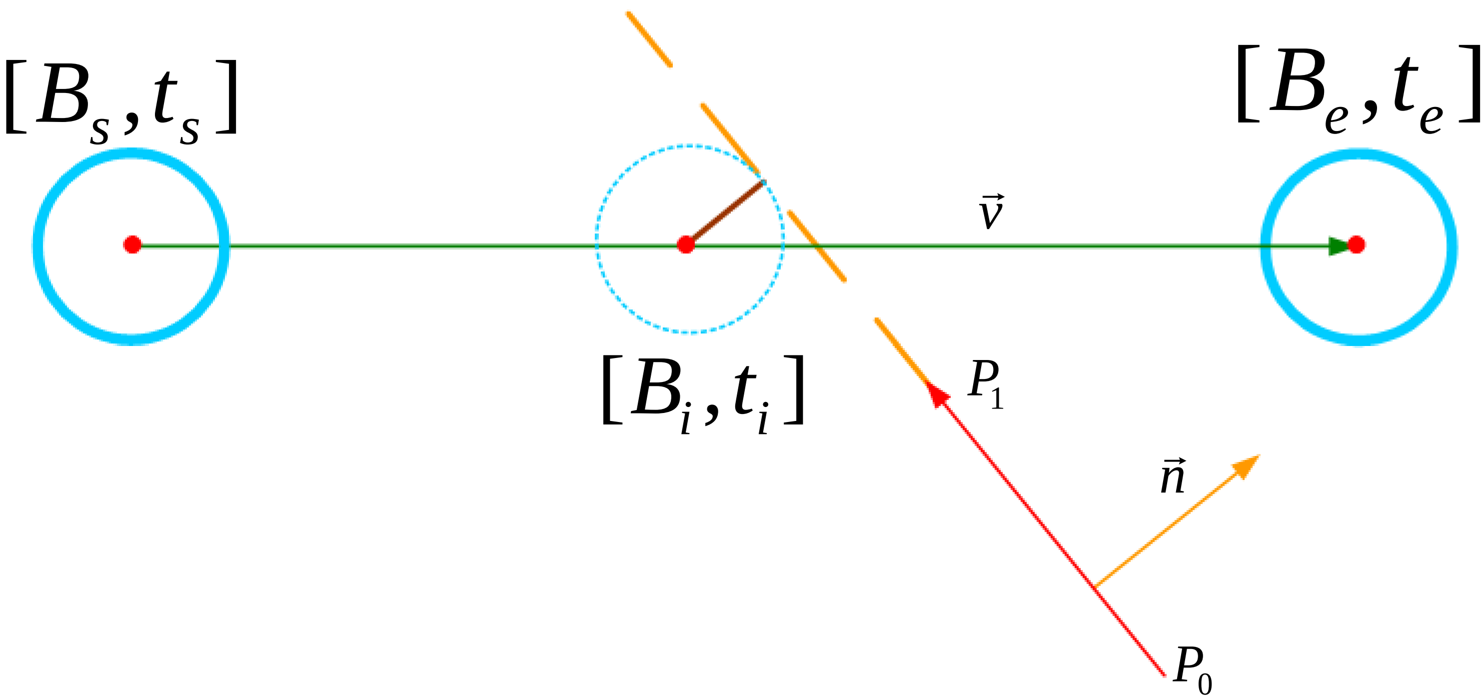
Test for Non-Collision (2/4)

$$(\hat{n} \bullet B_s - \hat{n} \bullet P_0 > r) \&\& (\hat{n} \bullet B_e - \hat{n} \bullet P_0 > r)$$



Test for Non-Collision (3/4)

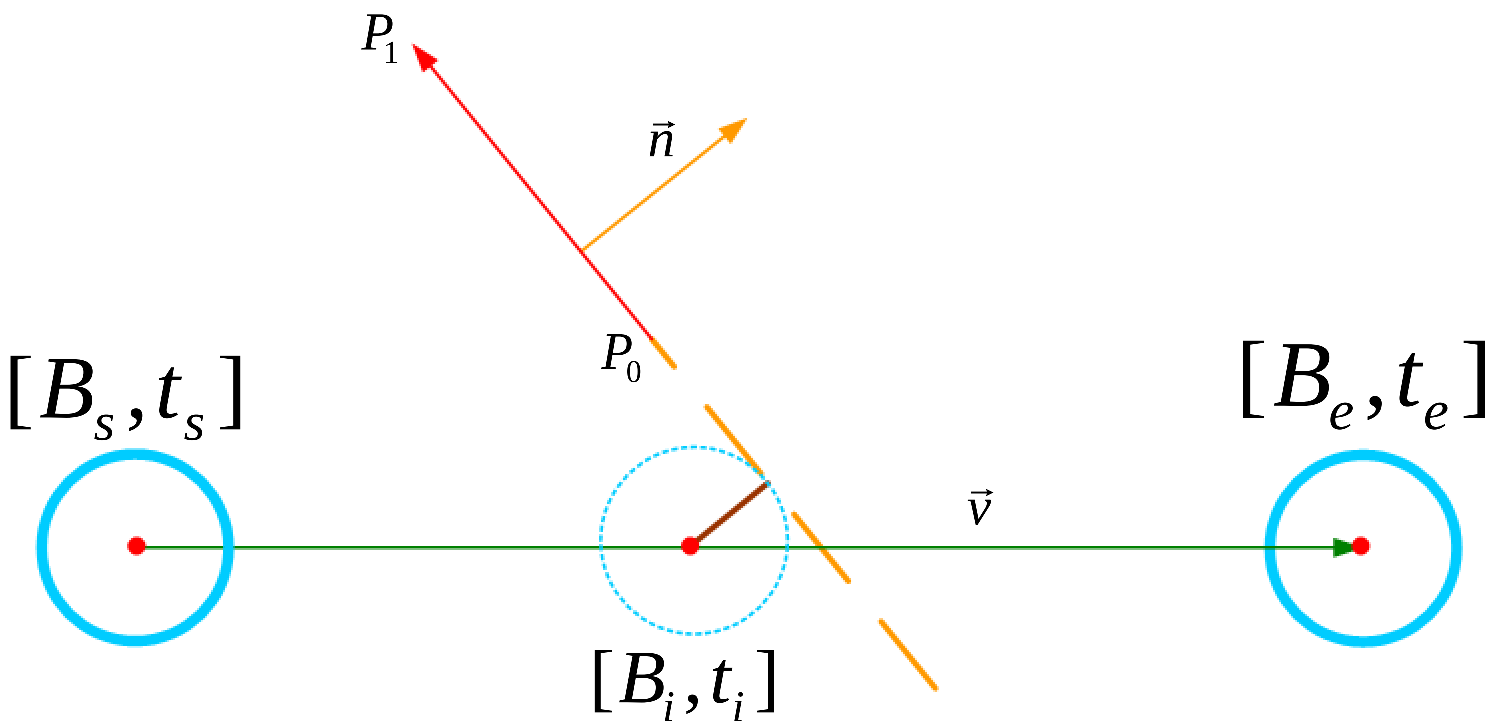
$$(B_i - P_1) \bullet (P_0 - P_1) < 0$$



Ball collides with infinite extension of wall… not finite wall!

Test for Non-Collision(4/4)

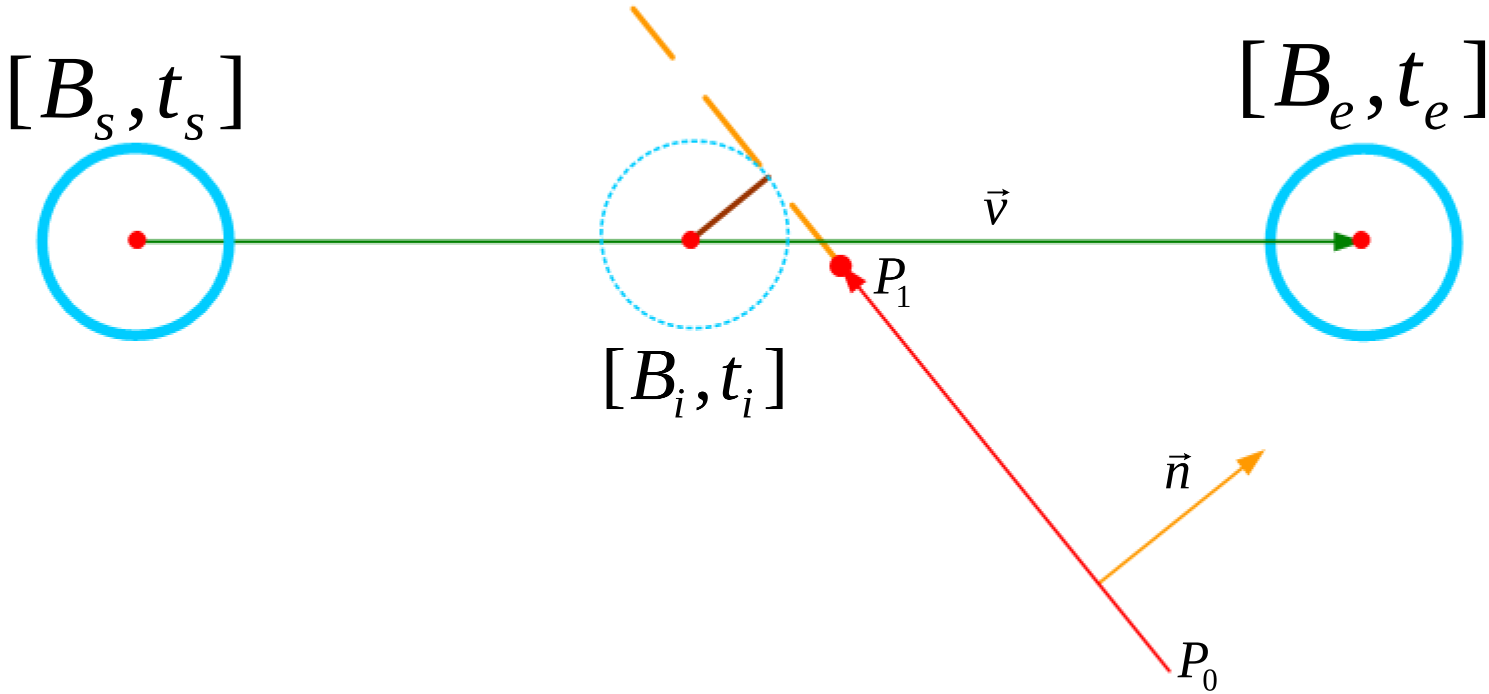
$$\left(B_i - P_0\right) \bullet \left(P_1 - P_0\right) < 0$$



Ball collides with infinite extension of wall… not finite wall!

But! We have a Problem

The intersection point B_i is not on the line, but the ball collides with the wall.



Steps

- Check for trivial rejection
  - B_s, B_e inside or both outside
  - Going from inside to outside and the collision type of the line segment is outside, and vice versa.
- Calculate the point and time of intersection
  - Check if the time is between t_s and t_e
- Check if the point of intersection is on the line segment