Universiteit Utrecht

COMMIT/

Perception of Collisions between Virtual Characters

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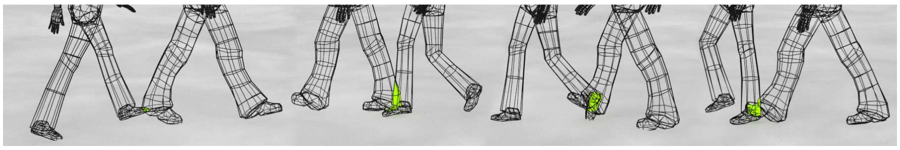


Abstract

With the growth in available computing power, we see increasingly **crowded virtual environments**. In densely crowded situations **collisions** are **likely** to occur. The choice in collision detection technique can impact the maximum density obtainable with a real-time crowd, and the perceived realism of the crowd.

We present an investigation into the accuracy of human observers with regard to the recognition of collisions between virtual characters.

User Study

In our main experiment, we showed the participants 32 videos depicting 16 colliding and 16 non-colliding situations.

In our second experiment, we showed each participant 50 static images depicting 25 colliding and 25 non-colliding situations.

Results & Conclusions

Participants show a **bias** towards answering “not colliding”.

Asymmetrical: slightly colliding cases hardest to recognise; a penetration depth of 3 cm shows the lowest accuracy.

Colliding → angle between characters most important;
Non-colliding → distance between characters most important.

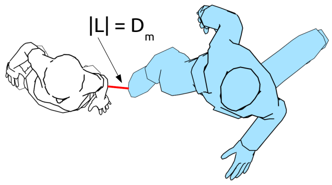
Participants were slightly **more sensitive to collisions in the upper body** than the lower body.

For faster collision detection of humanoid characters that match our perception, **simplified shapes should use bounded volumes**, rather than the commonly used bounding volumes. By ensuring a Hausdorff distance of at most 1.5 cm. the total penetration of two such meshes would be at most 3 cm and fall within the interval of minimal average accuracy.

Scan me for a digital copy of this poster.

Variables

- Character angle α ∈ {45, 90, 135, 180} degrees.
- The severity *S* of the (near) collision labelled as LOW, MEDIUM1, MEDIUM2 or HIGH, and expressed either as I_V when colliding or D_m otherwise.



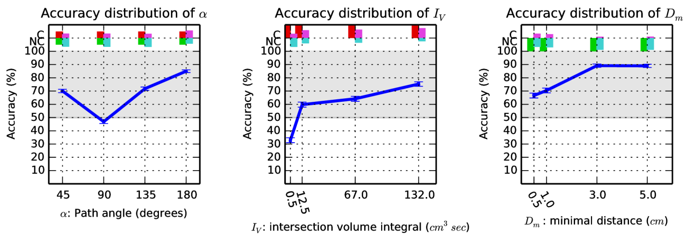
Label	Colliding: I_V	Non-colliding: D_m
LOW	0.5 cm^{3}s	0.5 cm
MEDIUM1	12.5 cm^{3}s	1.0 cm
MEDIUM2	67.2 cm^{3}s	3.0 cm
HIGH	132.0 cm^{3}s	5.0 cm

In the additional experiment we used static images, and the following variables:
- Mesh-mesh distance Dm ∈ [−0.10, 0.20] metres
- λ ∈ [0, ∞) measures the length of the visible (i.e. not occluded by the front character) part of L, measured in metres.

Analysis

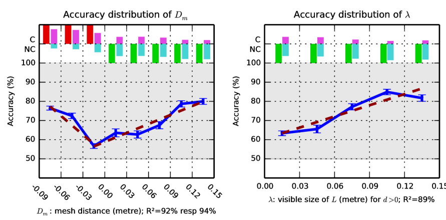
Animated characters:

Colliding: the most important factor was **α**
Non-colliding: the most important factor was $\mathbf{D_m}$



Static characters:

Confirms the asymmetric response to (non-)collision severity and higher sensitivity to upper body collisions



Future Work

We are interested to see the effects of various factors on the perception of collisions:

- Different **shadow** rendering techniques.
- **Background** texture & static objects, such as bushes, buildings etc.
- **Moving objects** in the background, such as other crowd agents.
- **Different shapes**, to see whether the observed effects are specific to the human shape.
- Collision **response** animations.
- Collision **avoidance** animations, for example by slightly moving hands or feet without changing global position & heading.