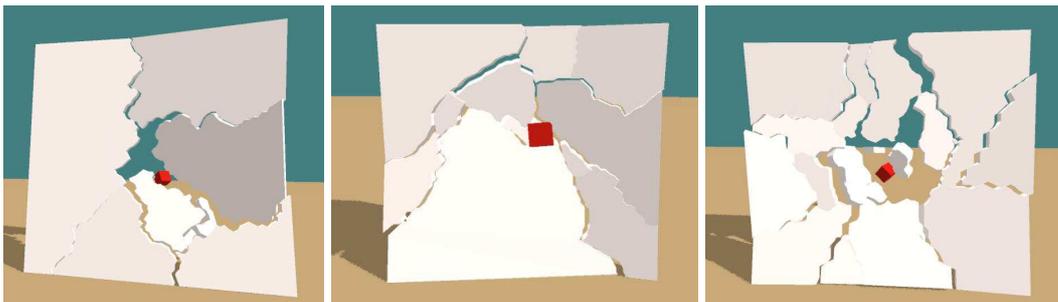


Real-time Procedural Modeling of Fracture of Brittle Materials in Games

This research addresses the problem of dynamically modeling the fracture of brittle objects in next-generation games. The dynamic modelling of a fracture refers to creating fractures on an object that looks different every time it is hit. The figure below shows a square concrete wall being fractured differently when hit at different areas. This is to simulate a real-world fracture. The fracture propagation and generation of fragments have to be done in real-time and look visually realistic.



Examples of a concrete wall being dynamically fractured.

The aim of the research is to develop a fracture framework that works with the game engine to fracture objects in the game. The model should dynamically fracture objects within the classification of brittle rigid bodies such as concrete, wood and glass. These objects are represented as three-dimensional surface meshes.

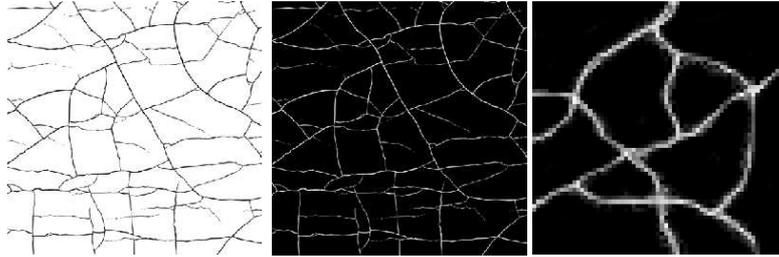


Photo of cracks on concrete and probability textures of concrete.

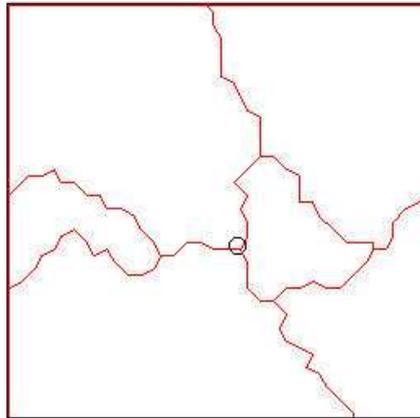
We use user created probability textures to generate crack patterns to fracture the object. These probability textures can be created by any paint tool such as Adobe Photoshop. First create a black image then draw white crack lines with a 1 pixel sized brush. To create blended gray lines, the hardness of the brush can be reduced.

The cracks are propagated based on the probabilities calculated from the neighbouring pixels as shown below. The probabilities are calculated from the probability texture of the object. The neighbouring pixels with the highest probability will be propagated to.

230	201	114	0	10
245				0
221		X		5
101				50
98	79	150	170	165

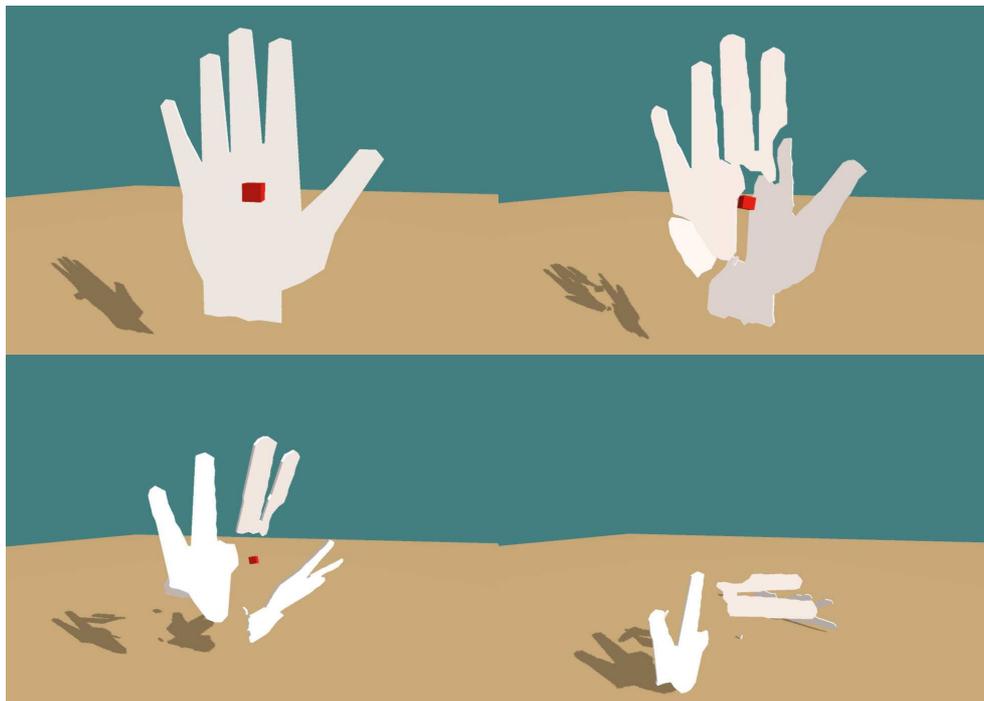
Selection of first neighbour to propagate crack.

After the 2D crack propagation has completed, a crack pattern is formed as a closed directed graph. A list of terminating nodes from the graph is also stored. The number of broken fragments to be generated is equivalent to the number of terminating nodes. The graph is then traversed to get the boundary vertices for creating the broken pieces.

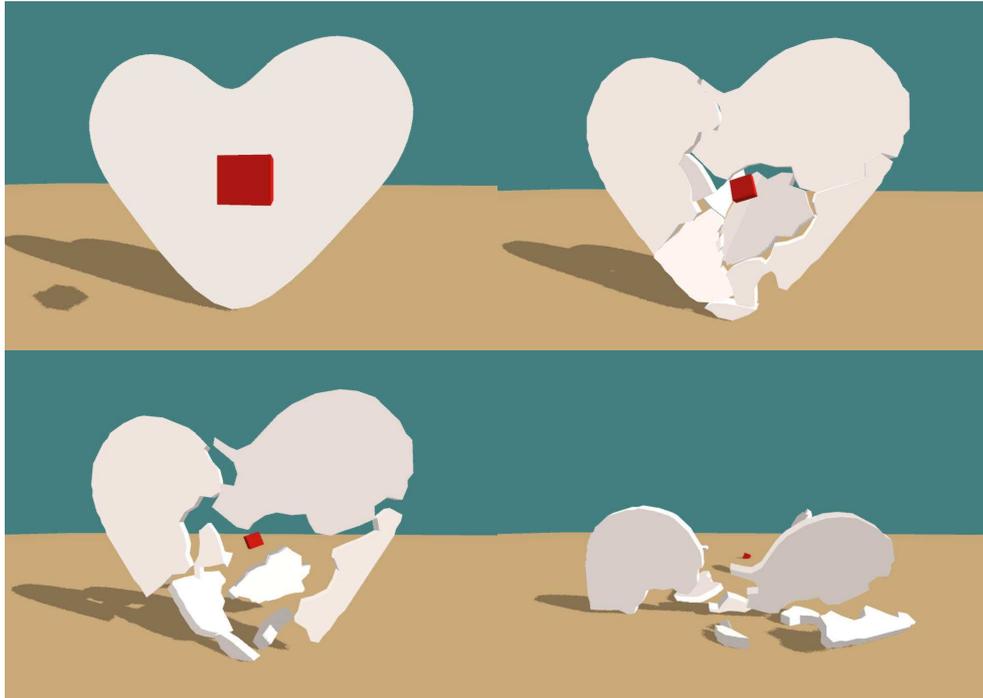


Graph traversal for boundary vertices.

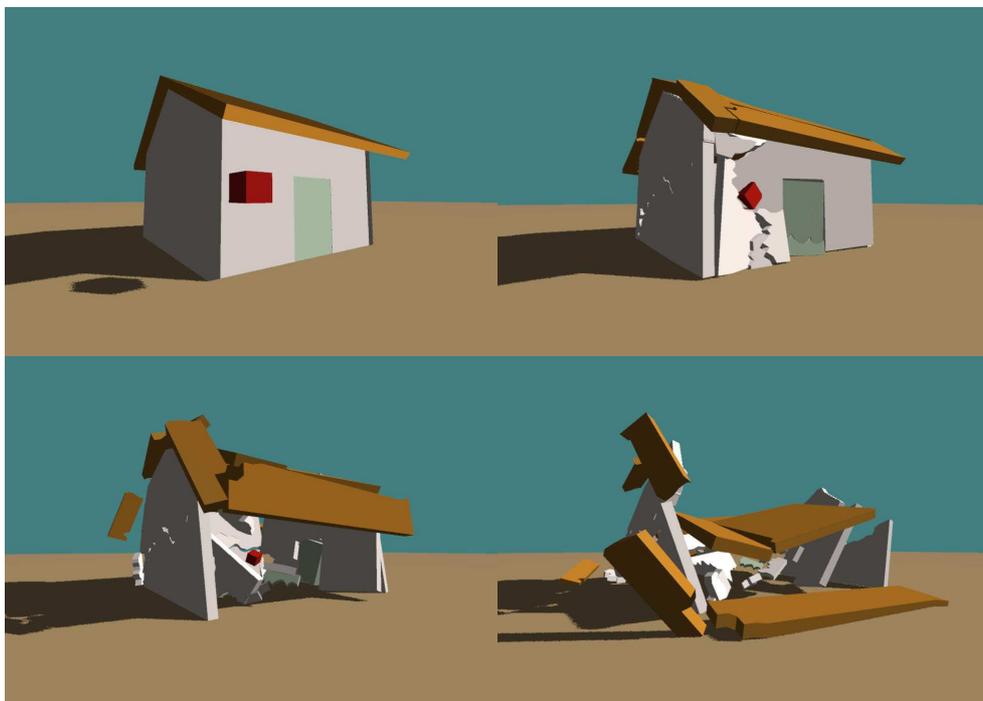
This method can be used to break arbitrary shaped objects as shown below.



A model of a palm shaped object being broken into pieces.



A model of a heart shaped object being broken into pieces.



The destruction of a house.