Tower Collision

New Mexico

Supercomputing challenge

Nuestros Valores team number 1022 or 81

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1. Introduction

We are using agent based models which we call turtles, Agents interact with other agents and interact with the environment which are called patches in the net logo **program.** Our paper is about a plane impacting a tower and what the effects would be. We would like to see if the towers could have collapsed differently also if the plane hit the tower in different heights would the tower have collapsed completely. We have created two different simulations to try our hypothesis. Our first simulation is to try our first hypothesis of a tower falling straight down. The other simulation is going to represent our other hypothesis of the tower falling side

Hypothesis

Our hypothesis is that the tower will fall straight down.

Figure 1- This is an image of the WTC burning to the ground. On the right image you can see where the new explosion occurred just below the dust cloud on the left image you can see the new explosion occur up-close.

2. Code examples

Figure 2- This diagram is showing how the turtles are pushing along the other turtles.

The turtle in the fault will give off its velocity and move the others along. This way they can be pushed. So it helps to push them to make the towers move and all the turtles will be pushing on to the other and thus telling the others to move along. This way they can

go in a direction. The turtles will be moving to the side and pushing the tower and with enough force the tower will fall over.

Compare and contrast

In the program we are modeling the twin towers. What we need to do is make the turtles hit the tower so this way we can show how the towers fall. In our project we need a strong force to move the tower because we want it to be as realistic as possible. We have done extensive research and the planes that hit the towers hit with a lot of force enough to collapse them. We need to use a lot of force to push the tower in our program.

The covalent bonds are about how metallic bonds are making it stronger. Because when they react to one another they push against each other and the force causes them to be moved.

The picture below shows a good example of what the molecules are doing in our project. Molecules are touching and combining and so they are moving all the other ones along. The tower gets pushed and it moves the molecules along to break the tower. You may study it to understand it better. To better explain them is to say each time one molecule touches another molecule it pushes the molecule and that's what causes the tower to be pushed down. The picture below is showing how our tower is being moved also how the molecules touch and react to one another.

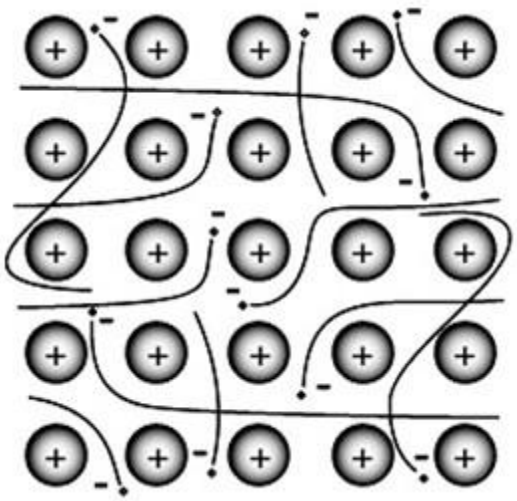

Figure 3-The image above is an example of Metallic Bonding

Metallic Bonding

Metallic bonding, is because this type of bonding is collective in nature, so that a single 'metallic bond' does not exist, Metallic bonding is the electromagnetic interaction between delocalized electrons, called conduction electrons, and the metallic nuclei within metals. When seen as the sharing of free electrons among a lattice of positively-charged metal ions, metallic bonding may be compared to that within molten salts, but this simplistic view holds for very few metals. In a more quantum mechanical view the conduction electrons divide their density equally over all atoms that function as neutral.

First what we did is built a model program of the tower. It was alright but when the tower would fall down it fell wrong. The turtles so I went on YouTube and I saw that when towers collapse they fall straight down. In order to make our project more realistic I had to start again. I will still show our old project to show how we started it and how we progressed through the tower project and how things changed.

We have started to build our new model that simulates how a tower really should fall down. It falls straight down instead of how we had it where the turtles fall to the side. We have moved impact further to the top of the tower. We did this because we looked up the towers and how they fell, and the plane hit the towers at nearly the top of the building.

We created a model of the towers by using real cubes. One of our team mates built a tower and we took pictures of the tower before we knocked it down. Then when we knocked it down, the towers side that got hit went down, but the opposite side was untouched. It is just a small simulation though we would have to do the simulation at least twenty times to get a good idea of how it would actually turn out.

www.nycarchitecture.com/GON/GON001A.htm

Figure 4- the first image is picture of the tower as it is collapsing to the ground. The second image is a picture after the 9/11 attacks.

Figure 5 this figure is a lil project our team member Samantha did.

Before

After

Abstract

Our paper is about a plane hitting a tower and how the tower would have been impacted differently if a plane where to have hit a tower in different spots how it would have damaged the tower. We have done extensive research and found that when a tower is in a controlled environment it falls straight down instead of falling to the side as if something where to actually hit it. Also we have changed our model in different ways I and another team have worked on two different types of tower collapses I worked on it falling straight down and the other team mate worked on it falling sideways. We basically want to recreate a tower being crashed into by a plane and we want to show how it would have fell if the plane would have hit the tower in different. We have even done a simulation of our model using plastic cubes and it worked out how we expected the tower was hit and one side was damaged more than the other. We have done a lot of experiments using our computer model and live experiments they have both come out as the same one side gets damaged more than the other.

Simulation results

What we have learned from our simulation is that it now acts as a real tower being impacted by a plane with enough force to damage the tower so that it is realistic. It is now falling to the side instead of straight down and that is how it should be because if a plane where to have hit it the damage is random but usually fall to the side and in a controlled demolition it falls straight down.

Tsunami Team Project

Our Tower Project is similar to the Tsunami project because it's the same mathematical model, but the tower model has stronger bonds and the tsunami one has weaker bonds. They both have a fault that simulates force being unleashed into a body of turtles. The force moves the turtles in both projects.

Summary

What we have doing this whole experience is how to work better in groups and how to use the net logo language and actually recreate something that has happened in the real world such as our project a plane hitting a tower with enough force to cause it to fall. Also what we done will help us learn more about the future programs it also helped us to be good presenters because we had to show are entire project when we had it on certain stages to different people.

When we first started the project we did not even know how to create anything so we started off slow and worked our way up to building a better model every time and each time we would make the project better in a way. So finally we got our project up to par and adequate enough to be a good tower being hit by a plane model.

The Code

```
breed [ land ]
breed [ bricks ]
turtles-own
[vx
vy
direction
velocity
]

to setup

ca
 create-land world-width * 3
   [
    set color gray
    set shape "square"
    set size 2
    ifelse who > world-width
    [
    setxy who world-height / 2 + 2
    ]
    [
    setxy who world-height / 2 + 1; command on how high the screen is
    ]
    if who > world-width * 2
    [
```

```
    setxy who world-height / 2 + 3
    ]
   ]
 ask patches[
    ;; if patches are between (0,0) to (0,edge)...
     if ( pxcor > -20 and  pxcor < 0 and pycor >= 0 - world-height / 2 + 4 and pycor <= 40 )
      [set pcolor gray]                              ;; ... draws left edge in red

                        ;; ... draws upper edge in red
    ]
end

to poof



ask patches
[
if pcolor = gray
[
sprout 1
set pcolor black

]
]
ask turtles
  [
  if breed != land
```

```
    [
    set breed bricks
    set color blue
    set shape "circle"
    set velocity 1
    ]
  ]
end



to limit

   if vx >= 1 ; if vx is greater then or equal to 1 it sets vx to 1
   [           ; 1 is the max energy it can have
   set vx 1
   ]
   if vx <= -1 ; if vx is less then or equal to -1 sets vx to -1
   [
   set vx -1
   ]
   if vy >= 1 ;if vy is greater then or equal to it sets vy to 1
   [
   set vy 1
   ]
   if vy <= -1 ; if vy is less then or equal to -1 sets vy to -1
   [
```

```
   set vy -1
  ]
end

to go
limit
if any? bricks-on patch-left-and-ahead 45 1 ; if there is a trtle in front then
 [
 ask one-of bricks-on patch-left-and-ahead 45 1
   [
   set vx vx + ([vx] of myself) ; give it our velocity
   set vy vy + ([vy] of myself) ; give it our velocity
   set ([vx] of myself) ([vx] of myself) * loss / 100
   set ([vy] of myself) ([vy] of myself) * loss / 100
   ]
 ]
if any? bricks-on patch-right-and-ahead 45 1 ; if there is a trtle in front then
 [
 ask one-of bricks-on patch-right-and-ahead 45 1
   [
   set vx vx + ([vx] of myself) ; give it our velocity
   set vy vy + ([vy] of myself) ; give it our velocity ;
   set ([vx] of myself) ([vx] of myself) * loss / 100
   set ([vy] of myself) ([vy] of myself) * loss / 100
   ]
 ]
if vy + vx > 1.5
```

```
  [
  set color orange - 3
  ]
ifelse any? turtles-on patch-ahead 1 ; if there is a trtle in front then
  [
  ask one-of turtles-on patch-ahead 1
    [
    set vx vx + ([vx] of myself) ; give it our velocity
    set vy vy + ([vy] of myself) ; give it our velocity
    set ([vx] of myself) ([vx] of myself) * loss / 100
    set ([vy] of myself) ([vy] of myself) * loss / 100
    ]
  ]
  [
  ifelse [pcolor] of patch-ahead 1 != black ;if the color is not black move forward
     [                              ; change the heading and repeat the steps
     set heading atan vx  (vy + .000000000000000000000001 );takes vy and adds a very
small number
     ]
     [
     set vx vx * .99 ;takes a certain percentage of energy from vx trtl
     set vy vy * .99 ; takes a certain percentage of energy from vy trtl
     if color = blue - 3 or color = blue
       [
        if breed != land
        [
        if xcor > world-width / 2 - 30
          [
```

```
          set velocity 0
          die
        ]
        fd  velocity * abs (( round vx + round vy ) / 2 ) ; shows the absolute value of a number
       ]
      ]
    ]
  ]
set heading atan vx   (vy + .0000000000000000001 ); after looking around tells them to look back down
fall
end


to fall
if breed != land
[
set direction heading ; set of original heading.
set heading 90
;set heading 90 + random 180
ifelse any? turtles-on patch-ahead 1
   [
   set heading 90 + random 180
   ]
   [
   set vy vy - .1
   ]
set heading direction ; setting the heading back to the original heading.
```

```
    ]
end

to fault
if who = 0  ;only for turtle 0
  [
  setxy -20 40
  set heading 180
  set color red
  set shape "airplane"
  set vx .2 ; sets velocity for x only for 0
  set vy 0 ;sets velocity for y only for 0
   ]

end
```