

# 3-D Modeling and GeoDesign

Sean William Morish from University College, Dublin presents "3-D Modeling and GeoDesign" at the 2011 GeoDesign Summit.

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## Video Transcription

**00:01** Morning everybody, my name's Shawn Morish. I have two positions.

**00:06** I'm a researcher with the University College Dublin in the school of architecture, landscape, and civil engineering.

**00:13** I head up or part of a group that is the urban modeling group.

**00:18** I'm also...work with as a...the 3D spatial manager for EMA Design here in California.

**00:26** So my focus is talking and working with three-dimensional and modeling three-dimensional urban environments...

**00:35** ...and to do that, one of the issues is, as Carl always talks about is...

**00:40** ...you need to get all this information into your system before you actually do any modeling.

**00:45** But how much do you need and where do you get it from is one of the things...

**00:52** ...that we've been looking at in the university and trying to...tried to address.

**00:57** So we went towards using lidar, and Dublin is, anybody who's been there...

**01:07** ...how many...has anybody ever been to Dublin? Can I have...

**01:10** So there's a lot of people who know Dublin.

**01:12** Dublin is a very old city. It was founded in the 858, so it's quite old, has a lot of the Vikings set it up...

**01:23** ...and through the years it was improved on and it served as a regency capital.

**01:32** It was one of the regency capitals for the British Empire in the 1800s.

**01:39** So a lot of Georgian architecture is very, very involved in the city.

**01:45** So it's now just been recognized as a UNESCO City of Literature so the city itself forms a basis for many of the stories...

**01:59** ...that many of the authors that you know about, and James Joyce who's up there, has written very well.

**02:06** So anybody's who's followed Ulysses can actually walk through Dublin...

**02:10** ...and see the areas that James Joyce talks about in his Bloomsday epic.

**02:18** Here we have the early 1900s picture of the GPO where the independence started for Ireland...

**02:30** ...in many ways, but it was destroyed afterwards and been rebuilt since.

**02:36** So one of our founders is, and very important, is Arthur Guinness, and he's got a large influence on the structure of the city.

**02:47** And the city has changed. Now we've replaced Nelson's Column with what we call the Spike in the city, in the center. It's a spire.

**02:56** And how the city has actually changed over time. It's become a bustling metropolis.

**03:02** We have Google. We have many international companies there...

**03:06** ...and we've got a good change of different types of transportation sites available as well.

**03:15** We've also got quite a number of extensive, different types of architecture...

**03:21** ...which have been coming to the city to change the process.

**03:24** So when you have all this change happening, how do you maintain and manage the existing structure...

**03:31** ...and use that...integrate the geodesign process into that existing structure?

**03:38** So with the number...large number of Georgian buildings we have...

**03:42** ...we've, over the years there've been a number of architectural inventories.

**03:48** So buildings of interest, buildings of merit have been surveyed by architects.

**03:55** The information of the interiors has been catalogued, from frescoes to architectural, Georgian architectural information...

**04:05** ...and all this has been stored in tables and then over the years it's been...sat there, and we've...in the college...we've taken it...

**04:13** ...and we've brought it into a online web-enabled system, which allows us to assist planners, architects, conservators...

**04:27** ...in being able to look at the different information that is out there...

**04:31** ...that they need to assess the state of the city for any future changes in the city's scape.

**04:39** And this is an example of Hybernia. It's an inventory of streets and buildings in the city.

**04:46** It's both tabular and spatially enabled.

**04:52** One of the largest changes that's going to occur in the next 10 years...

**04:57** ...if we have any money, we're slightly in debt like everybody else...

**05:01** ...Stephen's Green, to the airport, which will speed the access from the city to the airport...

**05:02** ...but there's plans to build the Metro North, which is an underground metro from the city center...

**05:17** ...and be able to get more tourists in.

**05:19** One of the problems with this is that Dublin is a city built on glacial till...

**05:27** ...which is not the best type of material for tunneling...

**05:31** ...and most of the city center is Georgian, unreinforced, masonry buildings.

**05:37** So you put tunnels on glacial till together, you have subsidence.

**05:42** We recently built a tunnel from the port to the airport for heavy-goods traffic...

**05:50** ...and one in five buildings on the route suffered some form of structural cracking.

**05:56** So we're focusing on how do you change this and mitigate this.

**06:02** And to do this, we had a lidar scan. So any of you who're familiar with lidar...

**06:10** ...it allows you to use a laser to pinpoint features and capture point clouds of features...

**06:21** ...normally would be the surface of the earth, but we're looking at buildings themselves.

**06:27** So most of the problems that have occurred in urban modeling from lidar is, you can capture the ceilings, or you can, sorry...

**06:36** ...you can capture the roofs of the buildings, but it's very, very hard to actually capture the facades...

**06:42** ...or the city structure itself, the footpaths, the street furniture, or any of that.

**06:49** You can do it by driving a vehicle through it, but then you don't capture the tops of the buildings.

**06:54** So we devised a survey process using helicopter and a dense lidar point cloud structure...

**07:05** ...which eliminates the shadowing effect that you have from buildings.

**07:10** So we were able to gather this height map of the city center, and while we were doing this...

**07:18** ...we were also...used the same process to actually colorize those points.

**07:24** So we actually not only have the points themselves, the intensity from the points...

**07:29** ...which is the amount of information that's returned, but also the actual real-life color as well.

**07:37** So, on the top right-hand side you have Trinity College, and from that we're able to model a three dimensional...

**07:47** ...this is totally made up of points, of the city's, of, this is Trinity College campus...

**07:58** ...and you can see...be able to extract out the building facades as well.

**08:04** And from that we're able to look at, not just the buildings, but also the tree health in the city...

**08:13** ...and also any of the information that's available in the city on the streets themselves.

**08:19** And we have a colorized from that.

**08:23** And then to look at volumes, to see where to be able to do things like volume calculations, sun-shadow calculations...

**08:32** ...reflectivity calculations, we were able to create a voxel model of the city, which doesn't quite represent it exactly...

**08:42** ...but it's close to, and it's as close, you know, you will get this type...

**08:46** ...this is a much more accurate model than a simple DTM or a DEM.

**08:52** So from the...how do we use this in a geodesign environment?

**08:58** One of the things to do is to look at how are these buildings affected, or possibly affected, by changes through tunneling?

**09:10** So we have our...we're able to extract out our building façade, and this doesn't give us information...

**09:16** ...or this doesn't give us the model of the building itself, but by using a series of buildings, extracting out that façade...

**09:26** ...creating a model of that façade, and then feeding that...automatically feeding that model into a finite element system...

**09:35** ...we're able to, one, create our building with the windows.

**09:38** It's a little rough at the moment. We're working on finessing that so we get a better model of the buildings themselves.

**09:46** And then using the tools in Finite Element Modeling, you're allowed to...

**09:53** ...and also the information that is fed into the system from the data that's extracted from your intensity and your RGB...

**10:03** ...so you can define whether a building is steel, concrete, masonry.

**10:08** You can assign values to the structure itself and get an analysis of how it is affected by changes in the ground.

**10:22** So we're integrating the above ground, we're integrating the land use...

**10:27** ...we're integrating the subsurface that is available as well...

**10:33** ...and then we're modeling these type of things.

**10:39** So here is just the...you know, these are the types of issues that we're addressing.

**10:44** So, many different formats, all...trying to bring them all into one cross platform and system...

**10:56** ...and then this is the output that we hope to receive.

**11:01** On the planning side then, we just have some of the processes that we used for planning.

**11:11** And then in the field itself, we're using these to look at different types of design in real-world...

**11:21** ...and look at the site analysis for areas...

**11:25** ...look at the different types of effects that land use and cut and fill slopes and other information that that would have...

**11:34** ...and then create 3D models of that for visualization.

**11:41** So that is all I have for the moment. So, thank you very much for your listening.