Posudek diplomové práce

Matematicko-fyzikální fakulta Univerzity Karlovy

Autor práce	Luis Sanchez		
Název práce	Generating High-Precision Navigation Mesh		
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Studijní program	Informatika	**Studijní obor**	Počítačová grafika a vývoj počítačových her

Autor posudku	Tobias Rittig	**Role**	Oponent
Pracoviště	KSVI		

Text posudku:

Topic Summary
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The thesis topic is located in the area of computer graphics, geometry processing and artificial intelligence. It has applications in computer games, robotics and other fields that rely on autonomous agent navigation.

The thesis presents a method to generate a simplified geometric representation of a scene that is used in path planning and other navigation tasks. The so-called 'navmesh' needs to be of simple, connected topology and contain the least amount of triangles while still preserving many details in the scene.

The common approach and industry standard uses an intermediate voxel-based scene representation to generate a navmesh. Such resampling introduces a loss of details and generally limits the quality of the output mesh.
The student instead proposes a different approach that directly operates on the scene geometry thus preserving important details around doorways and thin pathways. The results show a slightly slower runtime but a consistently higher output quality. In an equal quality setting, the novel approach is much faster.

Formal presentation
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Overall the formal presentation is very good. The English level is appropriate with only minor cases of missing articles or grammatical mistakes. The text is logically structured from overview to algorithmic details - even inside each chapter. The reading flow is uninterrupted and all information is consecutively introduced.

The introduction presents a good overview over the problem and shows all alternative options. The algorithm itself is introduced step-by-step with a high-level overview and corresponding screenshots before explaining each step in detail.

I appreciate the manually created illustrations for each algorithmic detail to visualize the problem discussed within the current paragraph. They use color encodings and are well integrated into the text flow.

There is a number of duplicate figures (2.1==2.9, 2.2 == 2.16, 2.3 == 2.30, 2.24 == 2.32, 2.3+2.4 == 2.33) which don't seem to be placed to stretch the thesis extent, but integrate well

into the argumentation flow and prevent the reader from unnecessary scrolling.

In subsection 2.5.3 the notation is a bit unclear and doesn't correspond to the illustrations.

My main concerns are with the related work section. In comparison, it is relatively short and only covers directly relevant algorithms on a high level. Data structures and the mathematical background for geometry processing that is used throughout the thesis are not covered. The references mostly concern algorithms from 20+ years ago and leave the reader wondering what happened in the field of path planning since (see questions).

Methodology
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Overall the methodology is sound and successfully results in the outset goals. The student makes no assumption about the input mesh's topology further increasing the generality as well as the difficulty of the assignment.
The algorithm only exposes intuitive parameters where absolute necessary, such as the agent's dimension and movement capabilities while keeping details hidden from a potential user.
The results convince in quality and stable speed, especially with non axis-aligned walls, round corners and thin passages where the voxel-based approach produces much lower quality.

Implementation
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The supplied software documentation was sufficient to test the application personally and verify the results. I did not build the application from source code myself, but the attached code and the build instructions leave no doubt it should be possible to replicate the results.
During a personal interview with the student I received a personal commented demonstration and look through the code. The student left a very knowledgeable impression and no doubts that he has a deep understanding of the presented topic.

Questions
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- I understand there are two basic approaches to navmeshes. What are the developments within these in the last 20 years since? How do neural networks play a role in AI navigation these days?

- What are the default cell sizes for recast in comparison to the high-quality sizes you chose?

- Would you be able to show actual path-finding results on your navmeshes?

Práci doporučuji k obhajobě.

Práci nenavrhuji na zvláštní ocenění.

Pokud práci navrhujete na zvláštní ocenění (cena děkana apod.), prosím uveďte zde stručné zdůvodnění (vzniklé publikace, významnost tématu, inovativnost práce apod.).

Datum **Podpis**