THESIS REVIEWER'S REPORT

CZECH TECHNICAL UNIVERSITY IN PRAGUE

I. IDENTIFICATION DATA

Thesis title:	**Bounding Volume Hierarchies for Oblong Objects**
Author's name:	**Emese Szabó**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Computer Graphics and Interaction
Thesis reviewer:	Daniel Meister
Reviewer's department:	The University of Tokyo

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment   **challenging**

How demanding was the assigned project?
Efficient ray tracing of oblong objects is a topic that has been addressed by the research community with only partial success. The idea is to replace commonly used axis-aligned bounding boxes in bounding volume hierarchies by bounding volumes that fit better long or diagonal objects at a cost of the more expensive intersection test and more complex traversal procedure. I consider this topic as relatively challenging.

Fulfilment of assignment   **fulfilled with minor objections**

How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.
This topic can be approached from different directions. The primary goals have been achieved. However, my impression is that the student did only a bare minimum to fulfill the assignment, nothing extra has been done (e.g., parallel implementation is missing).

Methodology   **partially applicable**

Comment on the correctness of the approach and/or the solution methods.
I think the student approached the problem from the right direction. Nonetheless, the experimental setup is far from what we use in practice. The current unoptimized sequential implementation is much slower than using a standard bounding volume hierarchy. It is not clear how would the hybrid hierarchy compete in an optimized parallel implementation.

Technical level   **D - satisfactory.**

Is the thesis technically sound? How well did the student employ expertise in the field of his/her field of study? Does the student explain clearly what he/she has done?
I would expect a more rigorous approach, especially in the theoretical part, addressing the bounding volume computation. I miss pseudocode for the computation and some discussion including the time complexity and optimality. For example, saying just that the optimal solution is a complicated optimization problem is not sufficient.

Formal and language level, scope of thesis   **D - satisfactory.**

Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?
The structure of the thesis makes sense. Nonetheless, the text is a bit chaotic, omitting some details while some parts are repetitive. The text should have a hierarchical structure such that high-level ideas are described first, followed by details. However, the student sometimes jumps directly into details without any introduction (e.g., Chapter 2). Also, the text sometimes does not respect the structure of the thesis. For example, there are some experiments already in the theoretical part before the implementation and results, while some algorithmic details are in the implementation part. The thesis is written in English, but the phrasing does not flow well and there are occasional grammatical mistakes scattered through the thesis. Even if I read some sections multiple times, it was difficult to understand what was really meant. There are some other minor issues such that the student also refers to terms without a previous definition or description; or some figures are not referenced at all. All these issues make the text quite difficult to follow, sometimes leaving the reader only guessing the true meaning.

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Selection of sources, citation correctness   **B - very good.**

Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?

The quality of references seems to be adequate, and the bibliographic citations meet the standards. The student's work is also clearly distinguished from the previous work. I only miss some works discussing the bounding volume computations from a theoretical perspective such are those in computational geometry.

Additional commentary and evaluation (optional)

Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.

Some of the results are very interesting. Especially, I like the section about the hybrid hierarchy. The experiments showed that a two-level hierarchy with axis-aligned bounding boxes in the top levels and cylinders in the bottom levels may significantly reduce the total surface area of bounding volumes. Nonetheless, rendering times do not reflect this fact as the traversal is more complex than for the standard bounding volume hierarchy. However, this might be a promising direction for the future work.

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

Summarize your opinion on the thesis and explain your final grading. Pose questions that should be answered during the presentation and defense of the student's work.

I found the idea of hybrid hierarchies very interesting as it may significantly reduce the total surface area, which is in accordance with the conducted experiments. However, due to the limited experimental setup, it is not clear how would the proposed method compete in real-world applications. Nonetheless, my biggest concern is the formal aspect of the thesis. There are several issues that make the thesis very difficult to follow. Taking all these issues into account reflects the final grade.

Questions for the defense:
1] Would it be possible to use such hybrid hierarchies in the context of animated scenes using the refitting of bounding volumes? Is the refitting of cylinders efficient enough for this purpose?
2] A common practice to handle oblong objects is to use spatial splits (also known as SBVH) to achieve tighter bounding boxes. Do you have any idea how the hybrid hierarchy competes with SBVH regarding the total surface area?

The grade that I award for the thesis is **D - satisfactory.**

Date: **25.8.2021**   Signature: