Roads for Simulation

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Abstract —Road generation has not yet been widely covered in the simulation industries. This has been due to lack of data and the generally high technical demands. Driven by the autonomous driving testing and the requirement for content, new formats are today appearing on the market. TrianGraphics' has researched and developed new algorithms to create visual 3D roads networks including traffic logic automatically from this data. The results provide a completely new field of training scenarios in a cost-effective manner: urban scenes with realistic traffic.

1 INTRODUCTION

In the past years a lot of research has gone into all aspects of simulation mainly to achieve more realistic results with photo-realistic look. Roads have not yet been addressed and now become more and more important. One driving factor in this respect is autonomous driving testing in the automotive industry. But also in the military simulation industries realistic urban scenes are getting into focus and have not yet been widely covered. This is due to the fact that usually road generation content is the most demanding and time consuming to produce with convenient visual appearance and including traffic logic. However, training in realistic road and traffic scenarios is obviously very important for military personnel and for homeland security applications.

TrianGraphics has focused their research on automatic road generation from real-world data with a high level of automation. The current presentation will address general insights and various technical aspects.

2 DATA

The automatic generation of roads is highly dependent on the data quality. Collecting new data by a surveying company is cost intensive, as the lidar data needs to be classified and all lane edges etc. need to be extracted and delivered as vectors. Today a lot of hand work is needed for this analysis. Despite the huge effort some vendors and consortiums are currently building up world wide databases of accurate road data.

As exchange format for highly accurate data the open traffic logic format OpenDRIVE [1] has been widely used lately also by surveying companies for data exchange. But other more proprietary formats (Here HD Live Maps, NDS, …) are currently also pushing into the market.

We distinguish two types of vector input data, which are defined and described with their pros and cons in the presentation:

A) SD data that is basically based on a middle line with width information, lane count and road type.

B) HD data provides the middle line with an accurate spline description of each lane.

Data will always have flaws, especially when being collected worldwide and mostly for other applications (in this case for navigation and autonomous driving) than creating visual scenarios. Not all data flaws can be worked around, as the algorithms will come to their limits at some point. The data vendors will need to further improve the data coverage and quality in the next years.

3 APPROACH

In the described algorithm for generating road and crossing data one option is to convert SD data on the fly into HD data, based on the vector attributes. Only by editing the data the edited separators and crossing outlines are marked as non-temporary and are saved with the project. Thus SD data can be edited similarly to HD data.

Creating junctions in a robust way from the often non-appropriate data poses a lot of issues. The presentation will shortly outline issues and solutions in regard to roads and junctions generation also in terms of AI formats that are providing the traffic logic. The focus for the algorithms has been robustness, accuracy and realistic results.

Junctions from SD data are created by intersecting the road outlines, adding an offset and connecting the resulting points with Bezier splines to form the junction's outline. For HD data the AI splines on the crossing area are used to create a more exact outline.

Roads are created by forming temporary vector outlines for each lane that is triangulated and textured. The markings are represented by vector lines that receive appropriate generation templates, so called modifiers.

The generated roads and crossing geometry are cut into the ground mesh and exported into visual formats like fbx, OpenFlight etc. including the traffic logic in well-known formats like the already mentioned OpenDRIVE or proprietary formats like IPG's Road5.

For some applications a fully automated generation approach is sufficient, but for more advanced results major editing capabilities need to be provided. This has been realized by translating the input data into editable vector data that can be worked on with usual vector editing tools.

Additional meta data including material classification for sensor simulation is also exported. This data can be used for simulating infrared or radar sensors.

4 RESULTS AND DISCUSSION

Creating roads automatically from various types of input data is not trivial. Good results can be achieved with the data, robust approaches and algorithms described in this presentation. In practice real-world data is expensive to be generated and often has major flaws. In this case hand work is still involved for best results with appropriate accuracy.

5 FUTURE WORK

The algorithms will be further improved to handle certain data flaws, but it seems obvious that the data providers need to improve the quality to come to more cost-effective results. Due to the endless count of different road constellation automatically fixing drastic data flaws will typically lead to unexpected results in other data constellations.

6 CONCLUSIONS

Road content creation is very involved, but today can be approached with a high level of automation using advanced algorithms and new evolving formats currently reaching the market. However, hand work cannot be completely avoided.

7 AUTHOR/SPEAKER BIOGRAPHIE

Stephan Kussmaul is co-founder and managing director of TrianGraphics GmbH based in Berlin. With a technical background he has worked on automatic content generation in the simulation industries for almost 15 years. The past years he and his engineering team have researched on road generation and traffic logic.

REFERENCES

[1]   OpenDRIVE www.opendrive.org
[2]   TrianGraphics www.triangraphics.de
[3]   Here HD Live Maps
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