IS THE REQUIREMENT FOR POINT CLOUD CLASSIFICATION DEAD?

By Ted Knaak, President, TopoDOT
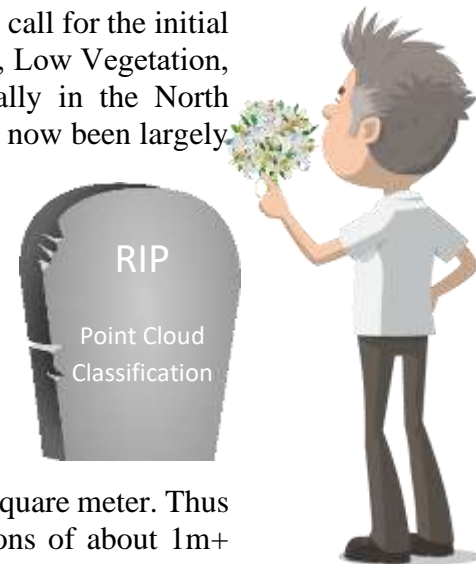
Mobile LiDAR system (MLS) point cloud delivery requirements often call for the initial "classification" of the point cloud data; typically identified as Ground, Low Vegetation, Medium Vegetation and High Vegetation. In recent years, especially in the North American market, such classification requirements for MLS data have now been largely discarded. In this discussion Professor Topo examines the origins of the classification requirement for MLS data and demonstrate how modern feature extraction techniques make this time consuming classification step not only unnecessary, but unproductive as well.

RIP

Point Cloud Classification
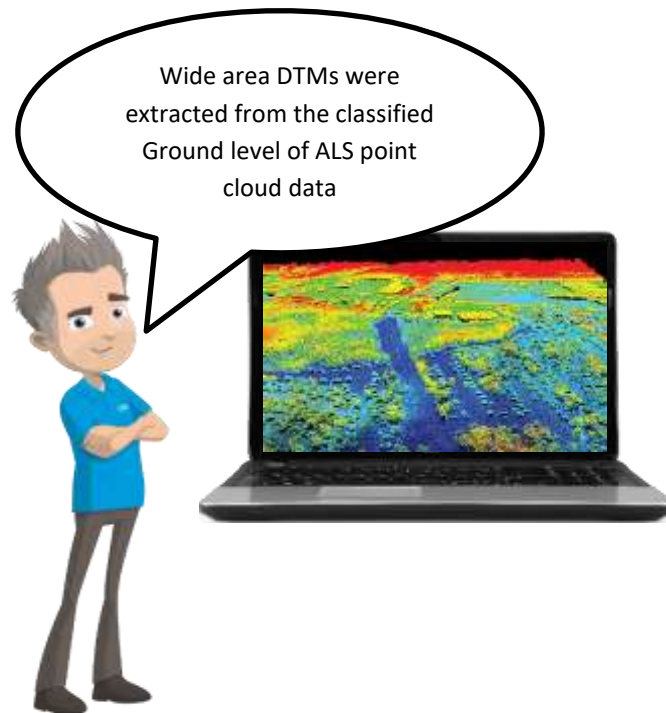
Origins of the Classification Requirement

We first note commercial airborne LiDAR systems (ALS) preceded MLS platforms by at least two decades. The spatial density of the point cloud data produced by these ALSs was typically about one point per square meter. Thus the data was basically used for wide area terrain mapping applications of about 1m+ accuracy.

One of the first software application challenges for extracting topography models from this data was to effectively "clean it up" by identifying and isolating points attributed to the ground and removing those from vegetation; hence the requirement and naming convention for classified data.
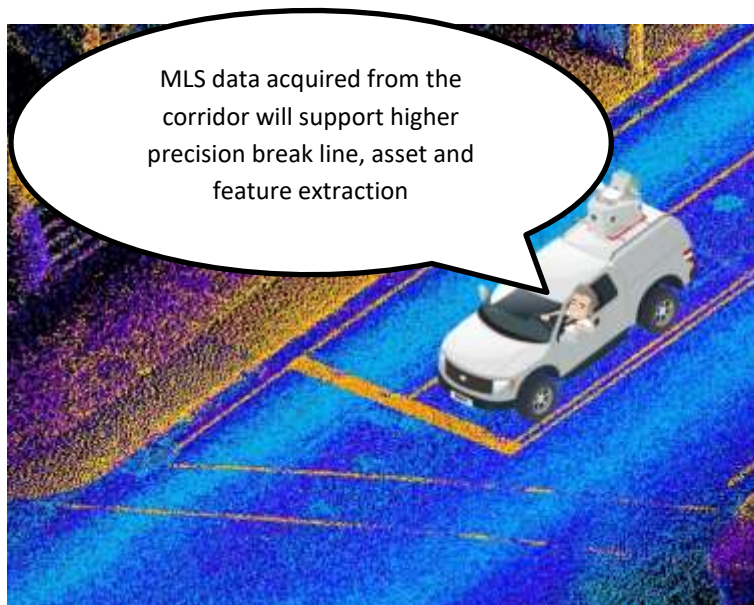
3D digital terrain meshes (DTM) were then automatically extracted from the ground classified point cloud. Now it should be pointed out that these DTMs were basic terrain models over wide areas. This data and the extracted DTM found many practical uses for large scale planning, power transmission line survey, forestry, hydrology among others.

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However the ALS data typically did "not" support feature extraction of sufficient accuracy and precision to meet traditional corridor survey requirements. Thus the format and structure of the extracted DTMs proved inadequate to meet the requirements of downstream planning, engineering and construction operations.

Wide area DTMs were extracted from the classified Ground level of ALS point cloud data

The Advent of MLS Data

MLS data acquired from the corridor will support higher precision break line, asset and feature extraction

The advent of terrestrial MLS changed point data characteristics dramatically. Data acquired along a roadway (or railway) corridor from such relatively short range increased the spatial density of the point cloud by several orders of magnitude. This high density data facilitated identification and extraction of topographic features such as break line vectors, signs, pavement markings, utility covers, etc. Close proximity to control survey
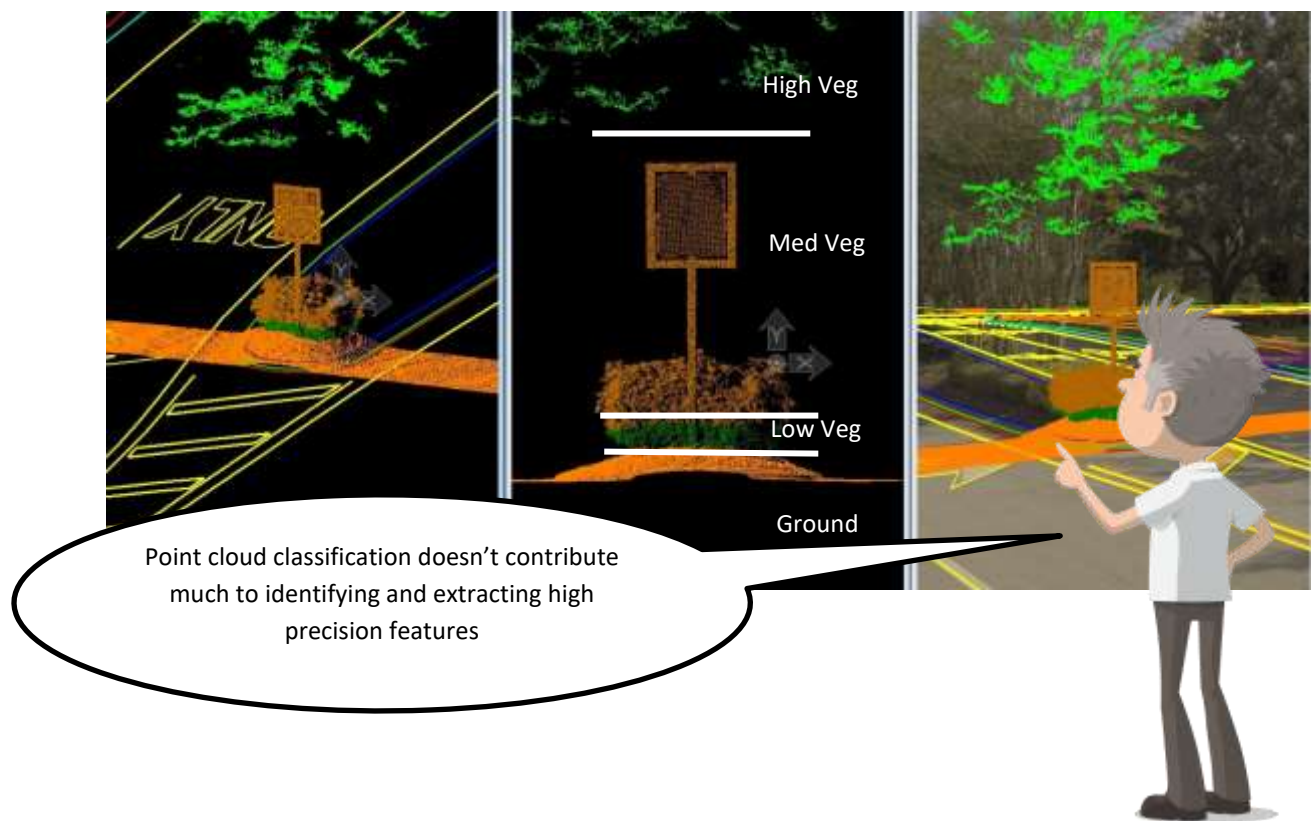
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reference targets facilitated more accurate registration of data.

MLS data characteristics showed the potential to support the extraction of topography models meeting design, engineering and construction requirements. However, these topographic models require significantly more metadata and precision than the wide area DTMs. Specific break lines, features and assets must be clearly identified within established CAD formats and extracted to very high levels of precision.

Earlier attempts to extract topographic models employed the same legacy software applied to ALS data for generating wide area DTMs. It became immediately evident that the surface mesh extraction tools were incapable of identifying and extracting features with any high level of precision. Furthermore the classification of data into traditional Ground and Vegetation levels made little to no contribution to the data extraction process.


Not only were important break line features unidentified, but the mesh represented topography breaks with "less" accuracy than the original point cloud data. Thus the legacy software process requiring data classification proved mostly inadequate in meeting the format, structure and accuracy requirements of traditional corridor topographic models.

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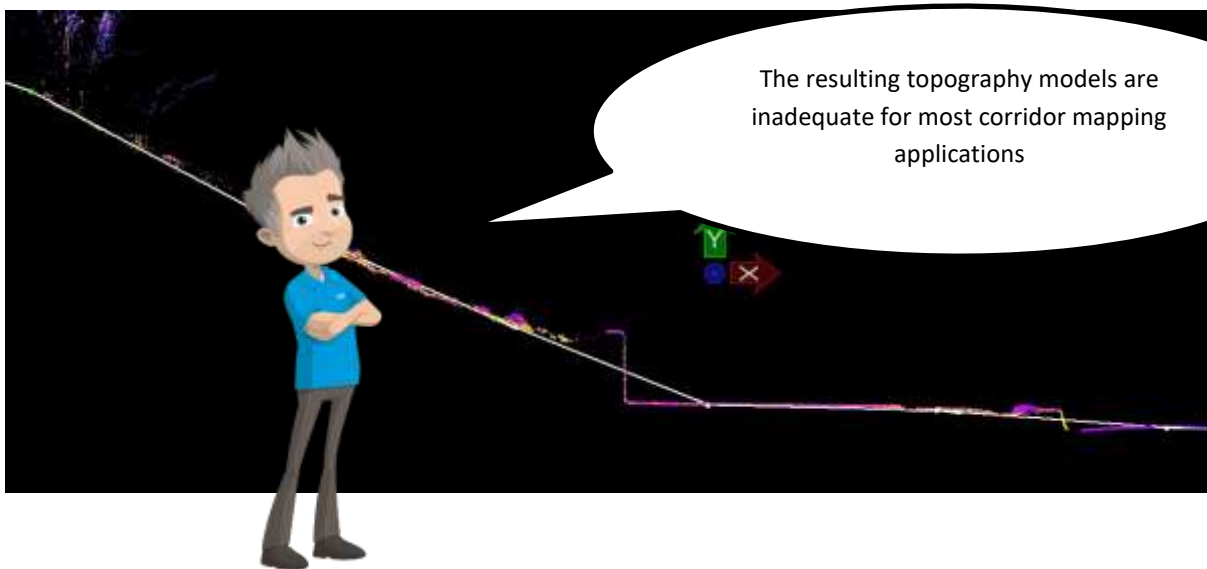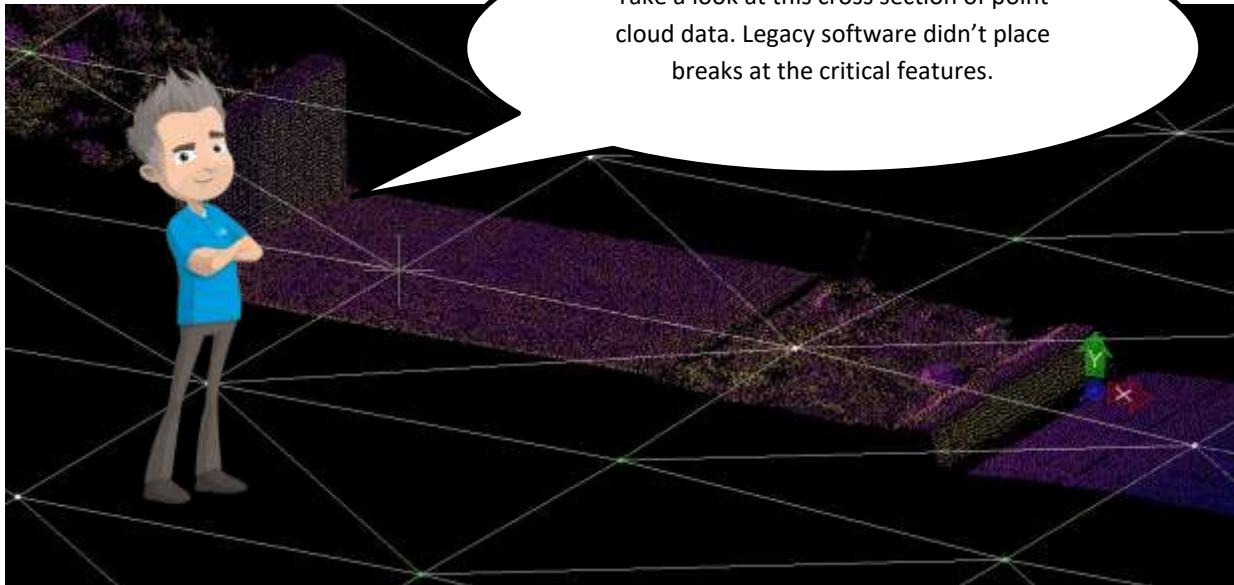
TopoDOT® Extracts High Quality Models Directly from Unclassified Data

The limitations of the legacy ALS software solutions made it clear a new approach to topography and model extraction was necessary to meet the requirements of transportation corridor applications. Team TopoDOT® proceeded to meet this challenge by first recognizing that a topography model was comprised of many different features and that each feature had its' own unique structure and characteristics.
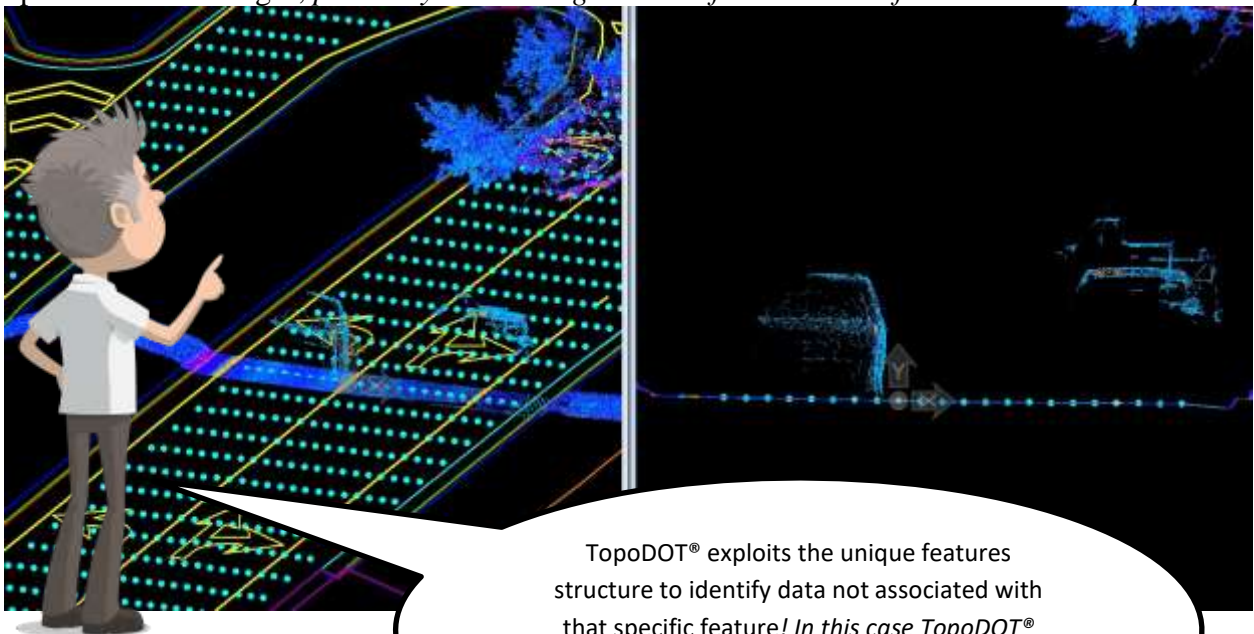
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Team TopoDOT® realized that an advantage of exploiting the unique structure of each feature for extraction is that the data not associated with the feature becomes more easily identified. Thus TopoDOT® has implemented filters *within each feature extraction tool* designed to ignore data not associated with the specific feature being extracted. This has profound operational advantages, *primarily eliminating the need for data classification or clean-up!*
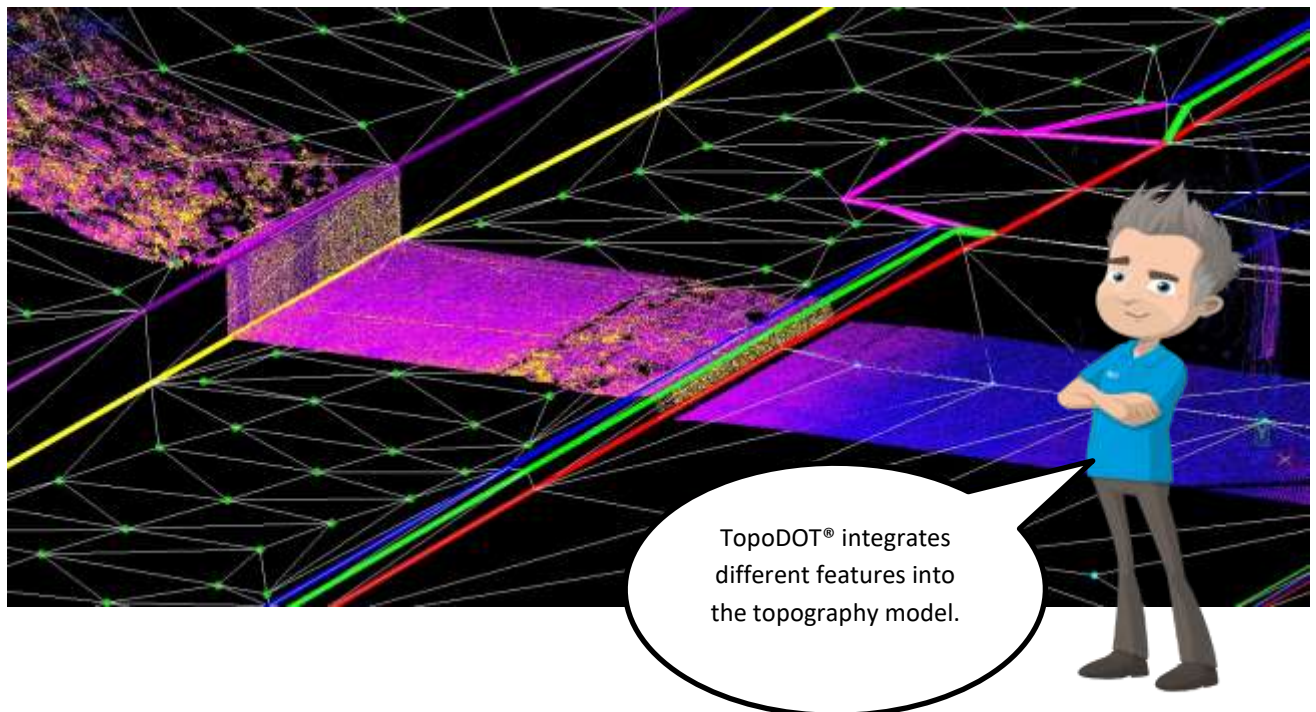
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To extract the topography, team TopoDOT® *abandoned the "one-algorithm-fits-all"* approach to surface model extraction. Today TopoDOT® tools are designed to exploit the inherent data structure of a specific topographic feature. So for example, the Break Line Extraction Tool would be used to extract curbs, the Road Extraction Tool to extract the road surface, the Elevation Grid Tool to extract bare earth surfaces, and the Asset Extraction Tool identifies and extracts signs, poles, and other assets.

These features are then integrated into the construction of a complete topography model. This is a highly automated process resident within most CAD software applications. Typically break lines, elevation points and other features extracted within TopoDOT® are identified to the DTM engine. The engine then constructs the model from these features. As illustrated in the following, the resulting DTM maintains the precision and accuracy of the original point cloud while meeting the format requirements necessary to meet downstream design, engineering and construction operations.

TopoDOT® integrates different features into the topography model.

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The resulting surface model maintains the precision and accuracy of the data while meeting the format requirements of traditional corridor topography models.

Is Classification Really Dead?

TopoDOT® does offer traditional data classification and classified data import capability. TopoDOT® has also expanded data classification in support of operations within the TopoDOT® Analysis tool suite. Classification has proven an effective tool in the areas of measurement extraction, monitoring of movement, verification of design and vehicle clash simulation within the point cloud. Therefore, classification is not dead! Rather it is largely confined to operations in which the classified data contributes to a specific analysis objective within localized areas of the point cloud.

Data classification and clean-up is no longer necessary! TopoDOT® is smart enough to extract the feature and leave the noise behind!

The Bottom Line

Long and tedious data classification/clean-up operations are no longer necessary to support topography extraction! TopoDOT® extraction tools effectively filter out extraneous data in parallel with extraction of the feature itself. The result is a faster process and a DTM surface model exceeding the requirements of downstream design, engineering and construction operations.

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