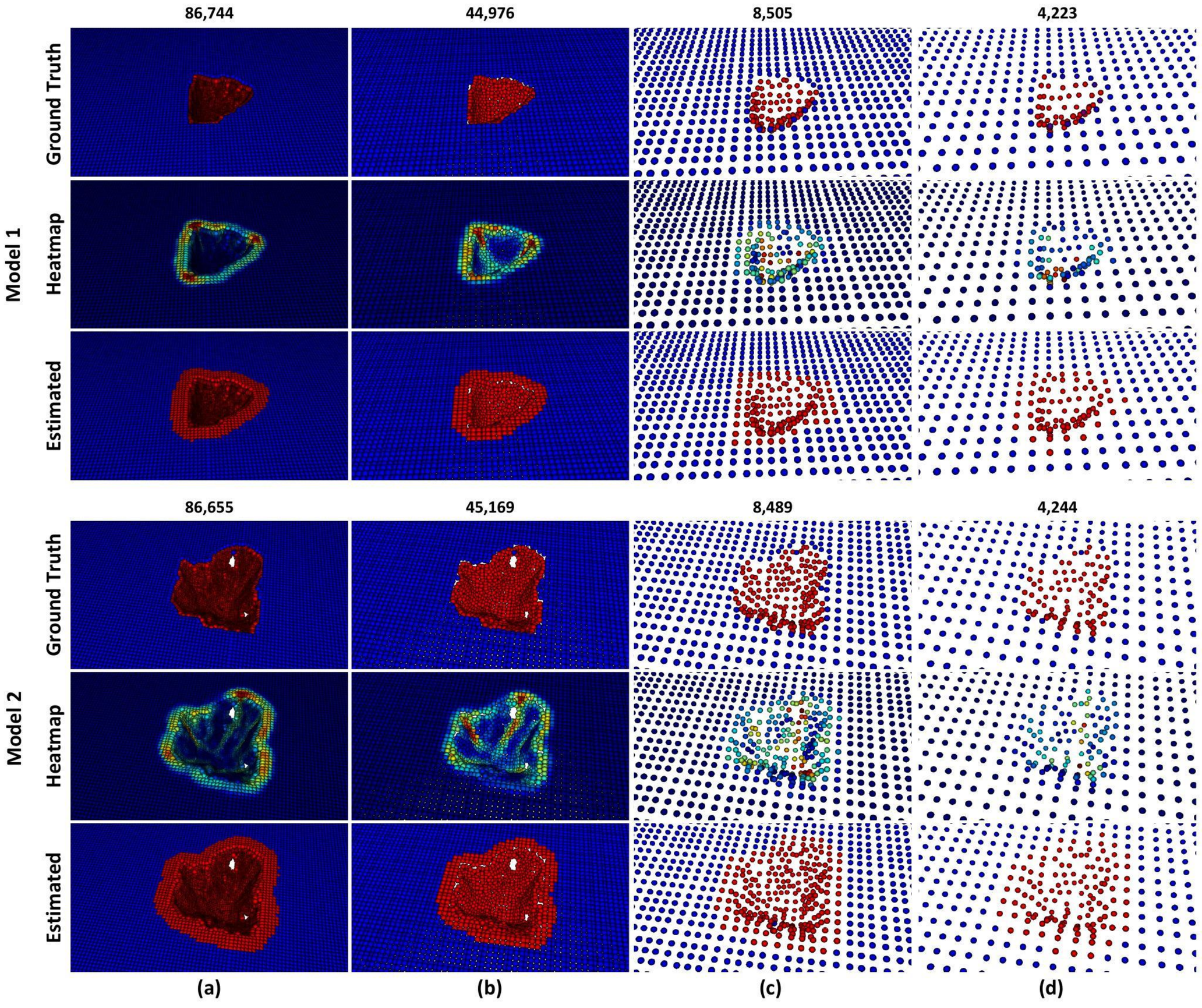

Fig. 14. Pothole detection in point cloud data of real potholes [63]. Two dense models are visualized: model1 (rows 1-3) and model2 (rows 4-6). For each model, the three rows illustrate (i) the ground truth, (ii) the heatmap visualizing the saliency map of the pothole and (iii) the estimated point cloud, respectively. The columns show results with decreasing density resolutions (in respect to the original model): (a) original model, (b) $\sim 50\%$ of the vertices, (c) $\sim 10\%$ of the vertices, (d) $\sim 5\%$ of the vertices.

this figure illustrates the RGB image presenting real road potholes. In the second column (Fig. 15-(b)), the corresponding point cloud with the relative texture is presented. The geometry represented by the 3D coordinates of the point cloud (without any color information) is presented in Fig. 15-(c). Fig. 15-(d) shows the ground truth vertices (in red) representing the pothole and Fig. 15-(e) presents our pothole estimation result. Figs. 15-(f) & (g) just present enlarged details of Figs. 15-(d) & (e), respectively, for easier visual comparison.

Table III provides a qualitatively comparison of our method versus other approaches of the literature. However, it should be mentioned that the results are not directly comparable because the other methods use only the visual information of the RGB images, while our method uses only the geometrical information of the corresponding point cloud.

VI. Conclusions

In this paper we presented a methodology for identification of road obstacles and their AR-based visualization targeting both the driver of the *ego* vehicleand other drivers in a spatial vicinity whose LiDAR device has not captured the obstacle information yet. AR-enabled technologies (beyond current AR headsets) are expected to be utilized in the near future for providing guidance to the drivers [69], [70], [71], increasing their situational awareness, and facilitating cooperation with other vehicles and road users (e.g., pedestrians, bicycles). The main purpose of the proposed system is to be capable to provide in real-time information to the drivers of autonomous and connected vehicles in cooperative driving situations, in order to increase their situational awareness.

Main emphasis was placed to the detection of potholes rather than protruding obstacles, because missing parts of the road present particular challenges that have not been handled efficiently by the available methods so far [8]. Our method is