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3D LASER SCANNING FOR ROAD SAFETY AND ACCIDENT RECONSTRUCTION

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13th International FIG Congress
October 8 -13, Munich

Accident Investigation

- Traffic accidents occur when deficiencies, errors, or unanticipated changes are present
- The investigation involves typically five levels:

(a) reporting (basic data collection)
(b) at-scene investigation (extra data eg tire marks)
(c) technical follow-up (data eg visibility)
(d) reconstruction (how the accident happened)
(e) cause analysis (why the accident happened)

Measurement Process

Current techniques
- 2D surveying - measurements of distances
- 3D surveying - total stations but disruptive to traffic
- GPS surveying - used in unobstructed areas
- Close-range digital photogrammetric systems - fast and accurate collection but expensive and complex to use

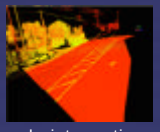
Terrestrial laser scanning (TLS)
- 3D documentation of current road design, accident events
- end products include 3D animations of scenes, 3D physical models

Road Safety

Sight distance: unobstructed area for safe turning movements
Drainage: from the secondary road does not run on main traffic lane
Geometric design features: eg lanes, island geometry, turning radii

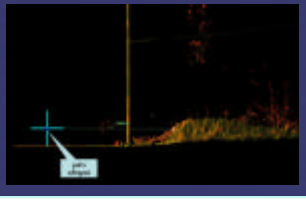
Use of 3D models from laser data provide the ability to define virtually several accuracy safety improvements

Experiments

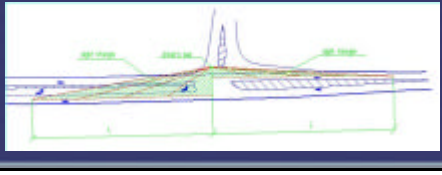


- Aim was to extract intersection features for road safety analysis using TLS and compare with ground-based geodetic methods (differences of 2cm)
- The experiment performed on a 3 leg at grade intersection (2 lane) rural road
- The intersection presents a bad design causing many accidents

TLS measurements



- TLS dense data is useful to extract design info, geometric features, line pole clearance etc
- Sight distance restriction are easily analysed from the TLS data



Experiments (cont'd)

Qualitative Assessment

Classification road data to assess the detail of information

Road configuration: straight / curves / grades

Roadway surface materials: estimates of speed from skidmarks or yawmarks

Traffic control devices: signals, signs, pavement markings, speed limits, prohibited turns, one-way streets etc.

Road accessories: curbs, guadrails, bridges, culverts, median dividers, islands, tunnels etc

Environmental effects

Light condition: classified to daylight, dawn or dusk and darkness

Road surface: classified to dry, wet, snow or icy and other (eg oil spill).

Quality of data

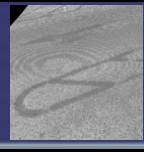
A qualitative indicator is assigned to indicate if parameter in the point cloud is :

- clearly visible (1)
- adequately visible (2)
- limited visibility (3)

Parameter	Light Conditions			Road Surface Conditions		
	Daylight	Dawn/ dusk	Darkness	Dry	Wet	Other
Road configuration	1	1	1	1	1	1
Roadway surface materials	1	1	1	1	3	2
Traffic control devices	1	1	1	1	2	1
Road accessories	1	1	1	1	1	1

Quality of data

Parameter	Distance from Laser Scanner		
	20-30m	50-60m	100-120m
Road configuration	1	1	1
Roadway surface materials	1	3	3
Traffic control devices	1	1	2
Road accessories	1	1	2



Example of a skidmark in a point cloud acquired at a distance of 20m from the laser scanner

Quality of data

Parameter	Sampling Interval											
	5-10mm				10-25mm				50-70mm			
	Daylight		Darkness		Daylight		Darkness		Daylight		Darkness	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Road configuration	1	1	1	1	1	1	1	1	1	2	1	2
Roadway surface materials	2	2	2	3	2	2	3	3	3	3	3	3
Traffic control devices	1	1	1	2	1	2	2	3	2	3	2	3
Road accessories	1	1	1	1	1	1	1	1	1	2	2	2

Concluding Remarks

- Need for reliable, accurate, and timely data to make decisions about traffic safety problems and countermeasures.
- Intersection-related crashes make a high proportion of total fatal crashes, and recording the current status may improve their design and operation.
- The greatly reduced on-scene time and a permanent 3D visual detailed record of the accident scene are the notable advantages of TLS.

Concluding Remarks (cont'd)

- Information from TLS can be integrated within traffic management systems for accident prevention.
- A number of experiments demonstrate that TLS operates reliably in daylight and darkness, but wet conditions may affect the measurements.
- The recommended distance from the scanner should be maintained in data collection, and sampling interval is based on particularities of each application.