

SAFETY BULLETIN

November 2000

Volume 9, No. 3


Triodyne Inc.

Consulting Engineers & Scientists - Safety Philosophy & Technology
 5950 West Touhy Avenue Niles, IL 60714-4610 (847) 677-4730
 FAX: (847) 647-2047
 e-mail: info@triodyne.com

VEHICLE SAFETY

Analysis of Vehicle Motion Using Aerial Photography

By Dror Kopernik, P.E.* and John Goebelbecker, P.E.**

Obtaining Close-Range Aerial Photographs

In 1995, Triodyne engineers developed AIRMAP (Accident Investigation and Reconstruction Mapping using Aerial Photography), an efficient, cost-effective method of obtaining low-altitude aerial photographs^{1,2} useful for mapping accident sites for vehicle accident reconstruction. AIRMAP field equipment consists of a tethered inflatable helium blimp (Fig. 1) which elevates a 35 mm camera above the site to altitudes of 100 to 1,000 feet. The camera is mounted to the belly of the blimp in such a way that it remains horizontal for obtaining vertical photographs. The resulting photographs have minimal perspective distortion allowing them to be scaled, similar to conventional maps. The scale is introduced by applying chalk marks at known distances directly on the roadway. The camera's shutter is activated by radio-controlled transmitter from the ground.



Figure 1 - AIRMAP

Documenting Vehicle Motion

A vehicle's motion can be documented with AIRMAP by taking a series of aerial photographs while the vehicle is driven through the camera's field of view. Locking the transmitter in the "Shoot" mode causes the camera to take photographs one second apart, thus displaying the position and orientation of the subject at one second intervals. Utilizing the photograph's scale, defined by chalk markings on the road, the distance traveled during each time interval can be measured from the photograph. Knowing distance traveled each second allows calculation of average vehicle speed.

Case Study

A tractor trailer traveling in one of two westbound lanes was rear-ended while turning right into a parking lot. According to the truck driver's testimony he had moved to his left such that half his rig was positioned in each lane prior to turning. The other driver testified that the truck had turned in front of him from the left lane. Following the accident, the right rear corner of the trailer was positioned on the line separating the two lanes.

* Senior Mechanical Engineer, Triodyne Inc., Niles, IL.

** Senior Mechanical Engineer, Triodyne Inc., Niles, IL.

MECHANICAL ENGINEERING:

Triodyne Inc. (Est. 1969)

Officers

Ralph L. Barnett
 Dolores Giddin
 S. Carl Uzgrig, Ph.D.

Mechanical Engineering

Ralph L. Barnett
 Dennis B. Brickman
 Michael A. Dilch
 Christopher W. Ferrone
 Suzanne A. Glowick
 John M. Goebelbecker
 Clifton Hales, Ph.D.
 Dror Kopernik
 Woodrow Nelson
 Cheryl A. Patten, Ph.D.
 Peter J. Poczynek
 Audrone M. Staks, Ph.D.
 William G. Switalski
 George J. Trznick, Ph.D.
 S. Carl Uzgrig, Ph.D.
 Raymond B. Wambaja
 James R. Wingfield, Ph.D.

Library Services

Merna S. Sanders
 Betty Bellows
 Cathy Friedman
 Donna Klock
 John Krstall
 Florence Lasky
 Jackie Schwartz

Information Products

Expert Transcript Center (ETC)

Merna S. Sanders
 Cathy Friedman

Graphic Communications

Robert Kouttry
 Charles D'Ecchia

Training and Editorial Services

Paula L. Barnett

Vehicle Laboratory

Charles Sinkovits
 Matthew J. Ulmerstine

Model Laboratory

2721 Alison Lane
 Wilmette, IL 60091-2101
 Bill Brown

Photographic Laboratory

7003 Beckwith Road
 Morton Grove, IL 60053
 Larry Good

Business Systems

Chris Ann Gonzales
 Cheryl Black
 Sandie Christiansen
 Rita Curto
 Sandra Prieto

Facilities Management

Peter Warner
 Neil Miller
 Jose Rivira

SAFETY RESEARCH:

Institute for Advanced Safety Studies

(Est. 1994)
 5950 West Touhy Avenue
 Niles, IL 60714-4610
 (847) 647-1101

Chairman

Ralph L. Barnett

Director of Operations

Paula L. Barnett

Information Services

Merna S. Sanders

Senior Science Advisor

Theodore Liber, Ph.D.

SAFETY PRODUCTS:

Triodyne Safety Systems, L.L.C.

(Est. 1998)
 5950 West Touhy Avenue
 Niles, IL 60714-4610
 (847) 677-4730
 FAX: (847) 647-2047

Officers/Directors

Ralph L. Barnett
 Paula L. Barnett
 Joel I. Barnett

President

Peter J. Poczynek

Vice President of Operations

Peter W. Warner

Senior Science Advisor

Theodore Liber, Ph.D.

Mechanical Engineering

Ralph L. Barnett
 Peter J. Poczynek

Aquatics Safety Consultant

Ronald M. Schroeder

ENVIRONMENTAL:

Triodyne Environmental Engineering, Inc.

(Est. 1989)
 5950 West Touhy Avenue
 Niles, IL 60714-4610
 (847) 677-4730
 FAX: (847) 647-2047

Officers

Ralph L. Barnett
 S. Carl Uzgrig, Ph.D.

MANUFACTURING:

Alliance Tool & Manufacturing Inc.

(Est. 1945)
 91 East Wilcox Street
 Maywood, IL 60153-2397
 (773) 261-1712
 (708) 345-5444
 FAX: (708) 345-4004

Officers

S. Carl Uzgrig, Ph.D.
 Ralph L. Barnett

General Manager

Ramesh Gandhi

Plant Manager

Bruno Stachon

Founders/Consultants

Joseph Gansacz
 Albert Kanikula

CONSTRUCTION:

Triodyne-Wangler Construction Company Inc.

(Est. 1993)
 5950 West Touhy Avenue
 Niles, IL 60714-4610
 (847) 647-8866
 FAX: (847) 647-0785

Officers/Directors/Managers

Joel I. Barnett
 William A. Wangler
 Joseph Wangler
 Ralph L. Barnett
 S. Carl Uzgrig, Ph.D.

CONSTRUCTION PRODUCTS:

Triodyne-Wangler Construction Specialties, L.L.C.

(Est. 1999)
 5950 West Touhy Avenue
 Niles, IL 60714-4610
 (847) 647-8866
 FAX: (847) 647-0785

Officers

Joel I. Barnett
 William A. Wangler
 Joseph Wangler
 Ralph L. Barnett
 S. Carl Uzgrig, Ph.D.

BUILDING MAINTENANCE:

Alliance Building Maintenance Corporation

(Est. 1999)
 5950 West Touhy Avenue
 Niles, IL 60714-4610
 (847) 647-1379
 FAX: (847) 647-0785

Officers

William A. Wangler
 Joseph Wangler
 David J. Smith
 Joel I. Barnett
 Ralph L. Barnett

CONSULTANTS:

Richard M. Bilal, Ph.D.
 Electromagnetic Compatibility
 Claudine P. Glebs Myers
 Biomechanics
 Richard Gullickson
 Industrial Hygiene/Safety/Chemistry
 Beth A. Hamilton
 Information Science
 David W. Levinson, Ph.D.
 Senior Mobilological Advisor
 Steven R. Schmid, Ph.D.
 Food Processing Equipment
 Darin Moshman
 Chemical/Environmental
 Engineering
 Harry Smith
 Electrical Engineering
 Kim M. Mieczkowski
 Fire and Explosion

The path of a similar tractor trailer turning into the subject parking lot was documented using the "Shoot" mode of AIRMAP described above. In Figure 2 the truck is driven according to the truck driver's testimony. In Figure 3 it is driven according to the other driver's account. Figures 2 and 3 demonstrate how in a turn, the rear trailer wheels would track closer to the curb than the front tractor wheels. It is, therefore, impossible under the truck driver's scenario for the right rear corner of the truck to come to rest on the lane line where it was found after the accident (see Figs 2C, 2D). Figure 3 demonstrates a turn from the left lane as described by the other driver. Figure 3C shows the right rear corner of the trailer in a position consistent with its location after the accident. Sideways positioning of the tractor trailer within the lanes was documented using chalk marks placed across the lanes 1 foot apart. Vehicle speed during the demonstration was determined using chalk marks placed 10 feet apart along the lanes and the one second intervals between consecutive photographs.



A



B



C



D

Figure 2



A



B



C



D

Figure 3

REFERENCES

- 1 Michael A. Dilich and John M. Goebelbecker, "Accident Investigation and Reconstruction Mapping with Aerial Photography", SAE technical paper No. 960894.
- 2 Michael A. Dilich and John M. Goebelbecker, "Accident Investigation and Reconstruction Mapping with Aerial Photography", U.S. Patent No. 5,628,033.