CALIFORNIA ASSOCIATION OF ACCIDENT RECONSTRUCTION SPECIALISTS

SKIDMARKS

Issue 16 Winter 2001

Inside this issue:

Front Page

Blurbs From the Board

ACTAR

Meet Your New Board Members

January Training Details

Schedule of Events

Board of Directors

Coefficient of Friction and Acceleration Testing

New Member Spotlight

Bosch and Accident Prevention

Return to:

CAARS Homepage

ARC Network

INJURY MECHANISMS DURING MOTOR VEHICLE COLLISIONS

This seminar will examine characteristics of biological tissues in order to investigate injury mechanisms and injury potential during motor vehicle accidents. Actual case studies will be used as examples to further facilitate learning. This course will benefit individuals involved in investigation and/or reconstruction of motor vehicle collisions.

SEAN D. SHIMADA, PHD

Dr. Shimada received his degree in Exercise Science with an emphasis in Biomechanics from the University of California, Davis in 1992. He continued his education at California State University, Sacramento where he received a MS in Kinesiology with an emphasis on Biomechanics in 1994. He further received a PhD in Rehabilitation Biomechanics from the University of Pittsburgh in 1998, and a second MS degree in Bioengineering from the university in 2000.

Currently Dr. Shimada is the President of Biomechanical Consultants of California, an occupational and forensic biomechanics firm based out of Davis, California. He was formerly employed at the California State University, Sacramento in the Department of Kinesiology, as an instructor and Director of the Biomechanics Laboratory. His primary area of consulting and research is focused on identifying, determining the likelihood, and prevention of injury.

such as Institute of Electrical and Electronic Engineers-Engineering, Medical, and Biology Society (IEEE-EMBS), Rehabilitation Engineering Society of North America (RESNA), Paralympic Congress (USOC, IOC), Forensic Accident Reconstructionists of Oregon (FARO), and the National Institute of Forensic Studies (NIFS).

COURSE OUTLINE

- What is BIOMECHANICS?
- Basic Anatomy.
- Injury mechanisms:
    1. Cervical Spine - "Whiplash"
    2. Thoracic Spine.
    3. Lumbar Spine.
    4. Shoulder Girdle.
    5. Elbow/Wrist/Hand.
    6. Hip/Knee/Ankle/Feet.
    7. Other:
        - Head Injury/Concussion.
        - Rotator Cuff Injury.
        - Thoracic Outlet Syndrome.
        - Carpal Tunnel Syndrome.

Dr. Shimada has authored four book chapters, over 15 referred journal publications, over 20 referred conference proceedings, and multiple abstracts. He has presented and conducted a number of research studies at meetings and conferences

Blurbs from the Board

Greetings to all:

As most of us have recovered from the events of September 11th, I would like to offer my sincere and heartfelt condolences to the families of the New York police officers, firefighters, and emergency workers who lost their lives. This terrorist act has shown us how our jobs are continuously changing, and those of us who are first responders, are on the front lines of America's first war of this new century.

CONFERENCE TALK: Our fall conference "2001: A Collision Odyssey" is in the history books. This was our first attempt at a joint conference and I am glad to report it was a huge success. We had just fewer than 100 in attendance over the three days, with at least one representative from each sponsoring organization. A big, big THANK YOU! goes out to our Administrative Assistants Nancy Degger and Jennifer Colunga. Without their support I don't think things would have gone as smoothly as they did. The next time you see Nancy or Jennifer, give them a well-deserved pat on the back.

Kevin Cassidy
Chair

Everyone that attended the conference received a blue nylon portfolio trimmed in tan leather, screened in gold with all of the logos of the sponsoring organizations: CA2RS, SOAR, NAPARS, FARO, and TAARS. Additionally, attendees received a notebook filled with each speaker's outlines, notes, and illustrations of their topic(s). We have a few extra of each, if you would like one or both contact CA2RS headquarters or drop me an e-mail at ca2rs@ca2rs.com. We are offering them for $30.00 each or a set for $50.00, while supplies last.

Gordon Gray
Vice Chair

Over the course of the conference, those that attended had the opportunity to learn from some of the best in our business. David Loft from SOAR was our master of ceremonies. On Thursday afternoon, Arnold Wheat (SOAR) started things off with his presentation on Incident Management. Then Jim Pursell (CalTrans) gave us an interesting presentation on Roadway Issues, everything you wanted to know about road construction and signage but were afraid to ask. We ended the evening with the Accident Investigation Tool Box. This was several individual presentations that generated group discussion. These presentations were Uses of a Total Station, by Rudy Degger (CA2RS), and Arnold Wheat (SOAR), Critical Speed Testing Results & Analysis by Tim Reust (Accident Science), and Photo Modeling by Stephen Neumann (CHP – Coastal MAIT).

Kerry Berg
Director

Ronald Shaffer
Director

Bud Crosthwait
Director

Kent Boots
Director

Benn Karne
Director

On Friday, we started the morning with a continental breakfast. Joe Del' Marmol spoke first about Staged Collisions. Mr. Del' Marmol is a retired CHP officer, who is now an attorney. During his carrier in the CHP, he worked in their fraud unit and then worked for the State of California, in the Department of Consumer Affairs. His experience and expertise was reflected in his presentation, which was not only educational, but entertaining. After a catered lunch of Mexican cuisine, our next presenter was Gerald Hasser (NICB). He continued on with Accident Fraud in the afternoon. The final speakers of the day were representatives from State Farm, Allstate, and Coast National Insurance companies, for the Accident Fraud Round Table. We ended the day with our Exhibitors Evening and some light hors d'oeuvres. On Saturday, we went "Back to the Basics" after a continental breakfast. Energy – Crush Measurement, Do's & Don'ts by Rudy Degger began the day. After another catered lunch, Tom Shelton (Shelton & Associates) discussed Momentum Basics.

IN WITH THE NEW: On Friday night during the conference near the end of the Exhibitors' show we held a general meeting. The most important business was the elections for Vice-Chair and three of the five Director positions. The election results are in. It is my pleasure to announce our newly elected members to the Board of Directors: Bud Crosthwait, (Concord PD); Kent Boots, (Orange Co. S/D); and Benn Karne, (Karne Eng.). Additionally, I have been re-elected to another term as your Vice-Chair. I look forward to working with all of you to improve CA2RS and better serve our members.

OUT WITH THE OLD: The time has come to say goodbye to close friends and associates within our organization. Many thanks go out to several past Board of Directors who have chosen not to renew their positions for another term as the result of changes in assignments and/or retirement. We are saying farewell to Al Sutcliffe, Kent Autrand, and Jim Willette. Thank you for assisting CA2RS and dedicating your time and effort to better our organization. At the January meeting there will be a special presentation to these dedicated individuals for their service to CA2RS.

THE FUTURE: Many plans are "in the works" for our first training session of 2002. In January, we'll have our Northern Cal. Meeting in the Davis area. The topic will be Biomechanics. If everything works out, our February 2002, meeting in Southern California will be in the Orange County area (right Kent!).
We are in the planning stages of our 2002 Conference. Be ready Southern California, we are visiting you next! If everything works out we will be in Anaheim for 2 to 3 days in October, 2002. We are working on the topics and are open for recommendations. If you have any ideas or have any special talents you would like to

offer, now is the time to step forward.

As you can see CA2RS is on a roll to start off the New Year right. Hope to see everyone up in Davis, in January.

Gordon Gray — CA2RS Vice-Chair

ACTAR Certified CA2RS Members

Michael Allision
Paul Arnold, Jr.
Donald Basham
David Beals
Stephen Benanti
Kerry Berg
Kent Boots #1170
Rochelle Carlton
Kevin Cassidy
Clark Corbin
Rudy Degger #447
Dennis Green #672
Steven Guderian
Jeffrey Guyer
Stephen Haverkamp
Kenneth Heichman
David Johnson
Benn Karne
Chris Kauderer
Daniel Mahoney
Michael Mahoney
Robert Mahoney
Patrick Moore
Terry Morris #1150
John Muse
George Ogilvie
Karl Pringle
Timothy Reust
Charles Ritchie, D.C.
Pat Stadler #1117
Daniel Trudell
Eugene Vanderpol
Daniel W. Vomhoff, PhD #483
Scott Wagner #1238
Mark Winter

If you are certified by ACTAR and do not see your name on the list, contact CA2RS Headquarters so that you may be recognized for this important achievement. If you would like your ACTAR number listed by your name please let us know. If you are not certified by ACTAR and would like information on how to obtain certification, contact ACTAR at www.actar.org, CA2RS Headquarters, or any of the listed persons.

The current ACTAR Examination Schedule is:

DATE: Monday, December 17, 2001	SPONSOR: **ACTAR**	LOCATION: Mesquite, Texas
CUTOFF DATE: December 3, 2001	COMMENTS: None	
DATE: Wednesday, February 13, 2001	SPONSOR: **CSP**	LOCATION: Golden, Colorado
CUTOFF DATE: January 30, 2001	COMMENTS: None	

For More Information:

PO Box 5436
Hudson, FL 34674-5436
Phone: 1-800-809-3818

E-mail: atbaxter@akos.net

WWW.ACTAR.ORG

Meet Your New Board Members

Kent E. Boots

Kent Boots
Director

Let me start by introducing myself. I have been a CA2Rs member since May of 1998. I have been an Orange Co. Deputy Sheriff for a little over 15 years. I have over 9 years experience in traffic collision investigation and reconstruction. I am a member of my department's Major Accident Reconstruction Team. I recently had the pleasure of attending the Fall Conference in Concord where I was elected to the CA2Rs Board of Directors.

There was a lot of valuable information packed into three days. The first day included incident management by Arnold Wheat. This block talked about identifying the need to establish a formalized structure to coordinate and manage traffic collision scenes. Roadway Issues in Accident Investigation by Jim Purcell followed this. Jim talked about all of the various issues that are taken into consideration in roadway design and how they relate to accident investigation. After dinner there was a round-table discussion led by Arnold, Rudy Degger, Tim Reust, and Stephen Neumann. Arnold talked about scene documentation, and Rudy talked about vehicle documentation. Tim presented his results and analysis of some critical speed testing. Stephen gave a presentation on some software he uses, PhotoModeler Pro. The entire evening was very informative.

The second day was devoted to staged collisions and accident fraud. The day ended with a round-table discussion led by various insurance company Special Investigations Unit Representatives.

The last day Rudy talked about using crush, it's limitations, and the do's and don'ts. In the afternoon Tom Shelton talked about the use of conservation of momentum.

I believe that the Conference lived up to the themes, "Education is the key" and "Back to the Basics." I look forward to assisting with and coordinating future quarterly training and the 2002 Fall Conference, which will be held in Southern California. If I can be of assistance to any CA2Rs members, please feel free to E-mail me at: kboots@ocsd.org.

Bud Crosthwait

Bud Crosthwait
Director

I wish to thank everyone that voted for me in the last election. In case you don't know me, I'm a Sergeant with the Concord Police Department and have worked there for almost 20 years. I am currently assigned as the Traffic Bureau Supervisor and a motorcycle officer. I'm one of our department's traffic collision reconstructionists. I also teach accident investigation classes for Los Medanos College and now the Contra Costa Sheriff's Department. I've been a law enforcement officer for over 28 years. I started out as a Deputy with the Orange County Sheriff's Department and was also an officer with Riverside PD. I look forward to working with all of the other board members and the organization as a whole to try to make this an even better organization than it already is.

Benn Karne

Benn Karne
Director

Hi, my name is Benn Karne, and I am honored to be a member of the Board. A mechanical engineer by training, I have been practicing for over 25 years (and hope to get good at it one day). During this time I have designed equipment ranging from micro-surgery devices to heavy duty truck chassis. My strong interest in vehicle accident and safety issues started in high school with a term paper--my premise was that Ralph Nader's complaints about vehicle safety were overblown. After researching the issue, I became convinced of quite the opposite point of view, and was happy to equip my subsequent road-racing Corvette with safety add-ons including a "bulletproof" rollcage (only tested once—it worked). Today I would still much rather have a strong seat and 5-point restraint than the standard shoulder belt and airbag in most current cars. (Why yes, there is more to this rant, thank you for asking…)

While I have worked for myself for more than ten years now, most of my accident investigation and reconstruction work has been done only in the last few years, after completing many classes and achieving ACTAR certification. As a civilian investigator I have much less experience attending crash scenes than most of the membership. I believe, however, that good education, training, and networking can make up for some of this deficit, and even allow one to excel in the field. It is this belief that induced me to join CAARS in the first place. Consequently, my priority on the Board will be to promote rigorous and useful training sessions. If you have comments or suggestions, feel free to send them my way: crashguy@california.com

JANUARY TRAINING

Learn *and* Relax at our next training event in January 2002

A continental breakfast will be provided at the Davis Indoor Sports Center (DISC) for attendees at our training event. Lunch will not be provided as part of the training, however lunch is available to purchase at the facility if you choose to stay close.

While the conference room will more than accommodate our attendance, we still need to ensure enough food and supplies are present at the training.

RSVP at your **earliest convenience**.

Call CA2RS Headquarters at (925) 284-7739
E-mail Jennifer at jennifer@rudydegger.com.

!!! Only current **CA2RS members** will be allowed to attend the training seminar **free of charge**. Non-members or guests will be charged a training fee of $25.00, as outlined in the article to the right.

New Policy regarding non-member attendance and Guests

Considering the size and fast growth of our organization, the CA2RS Board of Directors was forced to analyze the issue of charging non-members for training. The Board realized that with our growing numbers and aging of our group, it is increasingly difficult to keep track of guests' names. While the honor system of signing in one time only as a guest was a show of good faith, the Board decided that allowing even a few guests to receive free training more than once is not fair to current paid members.

Therefore our new policy is in effect, starting with our January 23, 2002 training event in Davis, CA. Non-members or guests will be charged 50% of the annual membership fee, or $25.00 currently. The Board appropriately reasoned that as our membership dues increase, so will the non-member attendance fee.

Thanks to our Board for keeping the current members' best interest in mind.

JANUARY TRAINING DIRECTIONS/MAP

Davis Indoor Sports Center (DISC) is located at 2801 2nd Street in Davis, CA, on the corner of Pena Dr. and 2nd St.

From Sacramento, take the Mace Blvd exit and proceed to turn right on to Mace. At the

stoplight turn left on to 2nd
Street. Follow 2nd for approximately 1.5 miles, DISC is located on your right hand side near Peak Performance.

From San Francisco, take the Richards Blvd exit. At the stoplight, turn left on to Cowell Blvd, following Cowell until turning left on Poleline Rd. After going over the overpass, turn right on to Fifth St., and then turn right on to Pena Dr. DISC is located on your left at the corner of 2nd St. and Pena Dr.

The training seminar will be held in the **Conference Room** at the Davis Indoor Sports Center (DISC).

Schedule of Events and Classes

1/23/02	Injury Mechanisms During Motor Vehicle Collisions in Davis, CA. Info. and RSVP: 925-284-7739 or jennifer@rudydegger.com
1/21-1/25/02 **3/25-3/29/02** **4/22-4/26/02**	Basic Accident Investigation by Contra Costa County Sheriff's Dept. For information or registration: 925-646-9051.
1/28-2/1/02 **4/1-4/5/02** **5/20-5/24/02**	Intermediate Accident Investigation by Contra Costa County Sheriff's Dept. For information or registration: 925-646-9051.
2/18-3/1/02 **6/17-6/28/02**	Advanced Accident Investigation by Contra Costa County Sheriff's Dept. For information or registration: 925-646-9051.
3/11-3/22/02	Traffic Accident Reconstruction by Contra Costa County Sheriff's Dept. For information or registration: 925-646-9051.

CAARS Board of Directors

CHAIR

Kevin Cassidy—San Jose Police Department
Phone: (408) 277-4654
201 W. Mission St., San Jose, CA 95110
e-mail: kc2938@pacbell.net

VICE-CHAIR

Gordon Gray—Stockton Police Department
Phone: (209) 937-7292
22 E. Market St., Stockton, CA 95202
e-mail: Gordon.Gray@ci.stockton.ca.us

DIRECTORS

Kerry Berg—Kerry A. Berg & Associates, Inc.
Phone: (909) 784-4505
7177 Brockton Ave., Suite 224, Riverside, CA 92506-2633
e-mail: KABRecon@aol.com

Kent Boots—Orange County Sheriff's Department
Phone: (661) 225-1121
23740 Magic Mountain Parkway, Santa Clara, CA 91355
e-mail: kboots@ocsd.org

Bud Crosthwait—Concord Police Department
Phone: (925) 671-3261
1350 Galindo St., Concord, CA 94520
e-mail: BudC@cpd.ci.concord.ca.us

Benn Karne—Karne Engineering
Phone: (510) 430-1119
6832 Mokelumne Avenue, Oakland, CA 94605
e-mail: karhu@california.com

Ronald Shaffer—Los Angeles County Sheriff's Department
Phone: (323) 357-5020
11703 S. Alameda St., Lynwood, CA 90262
e-mail: RTShaffe@LASO.org

CAARS POLO STYLE SHIRTS

These Polo shirts are primarily green in color with an embroidered logo instead of the standard silk screen. A few of the members on the Board are flaunting stylish leather briefcases with a unique gold embroidered logo. Take a look at our next meeting and you will see why our new items are so popular! Contact CA2RS Headquarters if you are interested in purchasing a new Polo shirt. If you need one sent to you, we will require a small shipping fee. **An order form is provided at the web site.** It is printable and you can send it in with your payment.ng fee. An order form is provided on the website.

Embroidered Polo Style Shirts $30.00
Sizes: M, L, XL, XXL (3XL available special order. Contact CA2RS Headquarters for details.)

CA2RS Headquarters
3650 Mt. Diablo Blvd., Suite 235
Lafayette, CA 94549 Phone: (925) 284-7739
Fax: (925) 283-8916
E-Mail: ca2rs@ca2rs.com
Website: www.ca2rs.com

Greetings CAARS Members

I would like to welcome all of the new members to the CAARS family, particularly the new Board members, Kent Boots, Bud Crosthwaith, and Benn Karne.

It is time to look forward to a new year of training. If you have topics of interest, please let the board know as soon as possible so we can try to fit them in the training schedule. If your agency or organization has facilities able to host a training day, please let us know so you can help to plan one of many successful sessions.

The Board and I are available for questions or comments. The e-mail system seems to be the best means of contacting me. I can be reached at RTShaffe@lasd.org.

I hope your Holidays are festive and the New Year is prosperous.

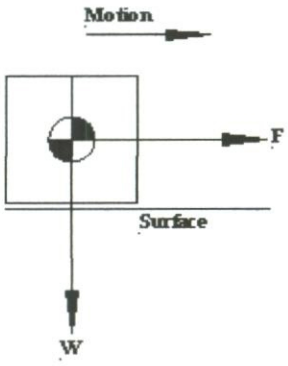
Ron Shaffer

COFFICIENT OF FRICTION AND ACCELERATION TESTING

by Kent E. Boots

This is the first part of a two-part article regarding coefficient of friction and acceleration testing that I conducted in November of 2000. The testing involved six fire apparatus vehicles, two police vehicles, and two police motorcycles. The testing procedures and results will be discussed in the next newsletter. In this article, I would like to discuss the definitions of coefficient of friction and acceleration. I would also like to describe the equipment that was used to conduct the testing.

Coefficient of Friction



Friction can be defined as the resistance of an object to motion caused by contact between two objects. If two objects are in contact, there is not any friction between them unless an attempt is made to move the objects with respect to each other. The Coefficient of Friction is a number representing that resistance. In accident reconstruction, it is relative to a specific vehicle on a particular roadway surface while the brakes of that vehicle are being applied. It is the ratio between the friction force and the normal force between two bodies sliding with respect to each other. In this diagram the coefficient of friction (μ) is simply the horizontal force (F) divided by the vertical force (w), which is the weight of the object when the object is sliding across the surface. This formula is

$$\mu = F/W$$

There are generally three types of friction that are addressed in traffic accident reconstruction[1]:

1. Static friction is defined using the above equation (for a level surface) when sliding is just beginning. When an object is just beginning to slide there is more force required to start it moving than there is to keep it moving. Therefore on a level surface, the horizontal force (F) is greater at the beginning than after movement has started.

2. Dynamic friction uses the same equation for a level surface. However (F) represents the horizontal force that is being applied once the object is sliding. This force is less than the horizontal force to overcome static friction.

3. Rolling friction, also known as rolling resistance, is the force that occurs when tires are rolling on a surface when there is no braking. These values are generally very low.

There are some basic assumptions for friction[2]:

1. *If the surface is horizontal, the horizontal force required to move the object is directly* proportional to the weight of the object.
2. Dynamic friction is lower than static friction, so it takes less force to keep an object sliding than it does to start it moving.

3. The friction force is not dependent upon the size of the tire contact patch with the roadway surface.
4. The friction force is not affected by a velocity change and remains constant.
5. The friction force is not affected by ambient air temperature or roadway surface temperature.

Acceleration

Acceleration is the rate of change of velocity with respect to time. Since velocity has the units of feet per second and time has the units of seconds, the units for acceleration are feet per second, per second (fps^2)[3]. Acceleration is expressed as a positive number unless a vehicle is slowing, then negative acceleration or deceleration occurs. A number representing the acceleration or deceleration of a vehicle or other body as it relates to gravity is a drag factor. A drag factor (f) is linked to acceleration (a) by the following equations:

$$a = f * g$$

$$f = \frac{a}{g}$$

Where f = drag factor
Where a = acceleration in fps^2
Where g = acceleration due to gravity; 32.2 fps^2

The objective of this testing was to obtain both normal and fast acceleration rates for the vehicles. The "normal" tests were what the driver considered a normal acceleration for his vehicle under everyday driving conditions. The "fast" tests were conducted at maximum rates with the drivers accelerating the vehicles as fast as they could and the vehicle were capable of.

Equipment

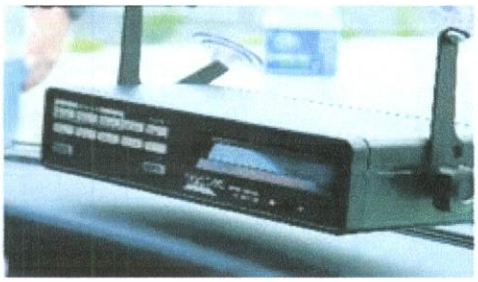
- **Skid Testing**
  Friction values were obtained using three methods. One method was to utilize a detonator unit (bumper gun) in conjunction with a handheld Kustom Signals Pro Laser III Lidar, where the speed and stopping distance were known and the coefficient of friction was calculated. The second method was to measure visible skid distances in conjunction with the Lidar, where the coefficient of friction was calculated. The third method was the utilization of an accelerometer.

- **Acceleration Testing**
  Acceleration rates were obtained using two methods. One method was to calculate rates using measured time to travel known distances. The second was to use data obtained from the accelerometer.

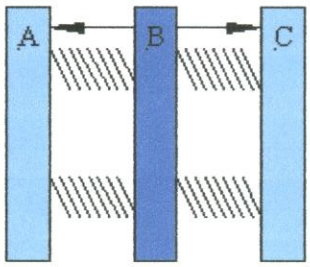
Detonator unit: A Y/P Products model #3529 electrical detonator (bumper gun) was used for skid testing. Devices of this type were originally used by The Automobile Club (AAA) as part of their Driver

Education Programs. It's primary purpose being to determine driver reaction times.

The device is composed of a metal backing plate, which supports two 6-volt normally open relays, two spring loaded hammer/firing pins, and a cylinder block capable of holding two .25 cal. detonator cartridges. The backing plate is supported on the vehicle bumper by a metal hanger. One relay is connected in series with a brake pedal switch (mounted to the pedal), and the other relay is connected in series with a handheld switch. The relays are then connected to either the electrical system of the vehicle or an external power supply.



Accelerometer: The units were mounted to the windshield of the test vehicles with suction cups. The units can operate on either 12V direct current supplied from the vehicle or on its own internal battery power. For this testing the internal battery, power was used. When performing a braking or acceleration test, the VC2000 will automatically calibrate itself for the slope of the road. The average G-Force (coefficient of friction) that the device indicates will include the grade of the road.



The VC2000 has three major components: an accelerometer, a crystal clock, and a micro controller. The accelerometer is comprised of three vertical plates. The center plate (B) is suspended by springs between the outer two plates (A & C). At zero G's, plate B is equidistant from plate A & C. When you apply the brakes, the vehicle pulls negative G's and moves plate B closer to plate C and farther away from plate A. When you accelerate the vehicle pulls positive G's and moves plate B closer to plate A and farther away from plate C. As plate B moves closer to one plate, the voltage between plate B and the other plate increases or decreases, depending on which direction it is moving, at the rate of one volt per G. 1/100 of a volt will equal 1/100 G, and 1 volt will equal 1 G.

By knowing the acceleration and the time, the micro controller calculates velocity every 1/100 second ($V = a * t$). By knowing the velocity and the time, the micro controller calculates distance every 1/100 second ($d = v * t$).

- **Skid Testing**
  A Vericom VC2000 accelerometer serial number 94421834 was used. For braking tests the Vericom VC2000 measures peak and average G-Forces (coefficient of friction), the distance of the braking run, the elapsed time of the test, and the vehicle speed at the start of braking. The unit also provides the value of G-forces in 1/10-second intervals. The device is set to begin the brake testing data collection when it senses that the vehicle is decelerating at a rate of .2 G or greater.

- **Acceleration Testing**
  A Vericom VC2000 accelerometer serial number 99504227 was used for acceleration

testing. For acceleration tests the Vericom VC2000 measures peak G-Forces and the speed and distance at which it occurred, average G-Forces (coefficient of friction), the distance of the braking run, the elapsed time of the test, and the vehicle speed at the end of the run.

---

1 Lynne B. Fricke, Traffic Accident Reconstruction, NUTI, 1990, Pages 62-3 to 62-4
2 ibid., Page 62-4

Please welcome our newest members to CA2RS

Nolan Woods	
Charles Davis, D.C.	Charles Davis, D.C.
Denise Escobar	San Jose Police Department
Robert Martin	Safety Solutions, Inc.
Michael Frain, P.E.	So Cal Edison
Craig Bothe	Turlock Police Department
Bill Kimble	Turlock Police Department
Lance Olson	Turlock Police Department
Jennifer Heckathorn	Turlock Police Department
James Silveira	Turlock Police Department
Jason Tosta	Turlock Police Department
Ramon Godoy	Turlock Police Department
Steve Hammell	Turlock Police Department
Greg Naff	Stockton Police Department
Brandon Yung	California Collision Analysis
John Thompson	Santa Clara Police Department
Suzanne Blick	San Mateo Police Department

BOSCH AND ACCIDENT PREVENTION

(Reprinted from SAE's Automotive Engineering, August 2001)

The design and development of technology that could totally prevent road accidents may sound like beyond-belief science fiction, but German electronics giant Bosch no believes it is possible. In fact, it says so with almost startling boldness. According to the company, because human safety is the highest priority in a vehicle, Bosch has been very busy in developing active and passive safety systems that could totally prevent accidents in a best case scenario.

To help achieve this, the company is focusing on "surround vision" radar and camera systems that will provide the driver with maximum warning of incipient danger and, if necessary, take action more quickly than humans could. That particularly centers on saving 0.5s driver reaction time in specific situations: "Studies indicate that about 60% of front-end crashes and almost one-third of head-on collisions would not occur if the driver could react one half-second earlier," said Dr. Martin Zechnall, President of the Semi-Conductors and Electronic Control Units Division of Bosch. "Accidents at intersections could be prevented by faster reactions", he added.

Although the theory of a surround system has been considered for many years (it was part of the 1980's pan-European Prometheus technology demonstrator project), it is only recently that sensor and microprocessor technologies have made such applications a practical proposition for series production. Adaptive Cruise Control (ACC) using radar – offered by Mercedes-Ben and Jaguar, among others – is an indicator of what could be achieved if that technology were extrapolated into the realm of safety systems. Dr. Zechnall stated that Bosch's ACC system, which is fitted to the BMW 7-series, uses an operating frequency of 77Ghz with an "operating span" of 390 feet. A very narrow lobe radar scans ahead of the vehicle, and if an object or other vehicle moving at a slower speed is detected, vehicle speed is adjusted via throttle settings or braking. The driver can preset the speed and safety margin distance.

But, said Dr. Zechnall, "In the near future, Bosch will also offer new radar and video sensors for vehicles. These open up a number of addition functions. Initially, short-range radar will be introduced that operates at a frequency of 24Ghz. It creates a 'virtual safety belt' around the vehicle ad several functions are realized. These sensors can even monitor a driver blind spot."

Video sensors would be complementary to radar. These could be developed from simple initial applications, including parking aids. A rear camera offers greater benefits if the sensed objects are interpreted via the image processing and the driver is warned in critical situations, such as a sudden lane change, said Dr. Zechnall. A camera positioned at the front of the vehicle would complement the ACC sensor. Up to five cameras would need to be fitted to a car if side-impact warning was also to be included. The stereo video camera used would be very small and barely noticeable. In an emergency, drivers might be alerted by a warning sound, but other methods being considered include steering wheel vibration and possibly a hazard symbol projected onto the windshield via a head-up display. In a full emergency, such as the immediate threat of a head-on collision, the system might apply the brakes almost simultaneously with the warnings. However, Dr. Zechnall stressed, "Such a system will not take over from the driver. It just assists – speeds up the reaction process. It must always be the driver who makes the decision to continue that process. We do not want to take away responsibility from the driver. Only in a few cases, where the system recognizes that the driver is not reacting sufficiently quickly, will emergency braking occur to reduce the effect of a crash."

Although technically feasible, Bosch does not, at present, envision the radar and video-linked system steering a car in an emergency. One of the reasons for that is the potential legal complexity in the event of an accident. But it is proceeding with the further development of ACC including its use in stop-and-go traffic. It envisions interaction between 77Ghz and 24Ghz radar sensors, plus an additional video sensor to achieve complete longitudinal guidance in every speed range. One of the company's visions for the future is that, if longitudinal guidance is augmented by lane-hold assistance (also a video-based system for lateral guidance), automatic driving will be possible in principle.

If Bosch achieves its aim of "surround vision" (it could be used to enhance night vision, too), it will require a totally new, overall system architecture and safety strategy. Timing of all this is a little vague, but Bosch foresees short-range radar in production cars by 2003 and video sensors by 2005. "Based on highly complex image evaluations with high-performance processors, an entire package of information will be consolidated. This can be used by several driver-assistance systems as a data source", said Dr. Zechnall.