



2016 Annual General Meeting

IEEE Southern Alberta Section

<http://southern-alberta.ieee.ca/>

December 9, 2016

AGM Agenda

- Welcome
- Dinner
- Chair's Report
- Treasurer's Report
- Chapter Chair Reports
- Awards
- Elections
- Keynote Presentation



Southern Alberta Section Chair's Report

Doug Brooks

Chair's Report

- ▶ Section Executive
- ▶ 2016 Year in Review
- ▶ Future Challenges

Section Executive

▶ Section Officers

- Chair: **Doug Brooks**
- Past Chair: **Lawrence Whitby**
- Vice Chair: **Dr. Arman Kiani**
- Treasurer: **Dale Tardiff**
- Secretary: **Dr. Zahra Lari**

Section Executive

► Chapter Chairs

- Power and Energy Society (PE31)/ Industrial Application (IA34)
Chair: **Shan Pandher**
- Antennas and Propagation (AP03)/ Microwave Theory and Techniques (MTT17)/ Communications (COM19) Chair: **Dr. Mohamed Helaoui**
- Systems and Solid-State Circuits (SSC37)/Circuits (CAS4)
Chair: **Dr. Leo Belostotski**
- Computer (C16) Chair: **Mohammad Moshirpour**
- Engineering in Medicine and Biology (EMB18) Chair: **Lawrence Whitby**
- Control System Society(CSS)/Instrumentation Measurement Society(IMS) Chair: **Matt Eskandar**

Section Executive

► Affinity Group Chairs

- Young Professionals Chair: **Tushar Sharma**
- Life Member Chair: **Lawrence Whitby**
- Teacher In-Service Program (TISP) Chair: **Dr. Kartikeya Murari**
- Women in Engineering (WIE) Chair: **Dr. Laleh Behjat**
- Special Interest Group on Humanitarian Technology (SIGHT) Chair: **Anis ben Arfi**

Section Executive

► Student Branch Chairs

- U of C Student Branch Counsellor: **Seyed Pouyan (Yani) Jazayeri**
- U of C Student Branch: **Samrat Kooner**
- U of C PES/IAS Student Branch: **Payam Zamanidehkordi**
- U of C MTT Student Branch: **David Garrett**
- U of C WIE Student Branch: **Alanna Devolin**

Section Executive

▶ Committee & Liaison Chairs

- Nominations Committee: **Lawrence Whitby**
- Awards Committee: **Dr. Zahra Lari**
- IEEE Canadian Foundation Liaison : **Rob Anderson**
- Membership Development: **Rod McNeil**

▶ Support

- Administrative Assistant: **Lisa Bensmiller**
- Web Site: **Lisa Graham**

Chair's Report: 2014 Year in Review

Membership				
	2013	2014	2015	2016
Fellow	14	13	16	7
Senior Member	96	97	99	95
Regular and Life Member	1113	1137	1119	1032
Associate Member	49	55	37	35
Student Member	82	90	68	95
Graduate Student Member	117	116	93	84
Grand Total *	1422	1453	1395	1348

*Not including Affiliate Members

Chair's Report: 2016 Year in Review

► Conferences

- IEEE Electrical Safety, Technical, and Mega Projects Workshop (ESTMP 2016)
Held 14 – 16 March at the Edmonton Marriott at River Cree Resort
Chairs: **Pankaj Sharma & Tim Driscoll**
- IEEE IAS Petroleum and Chemical Industry Committee (PCIC) Conference - 2017
Held 17 – 20 September at the Telus Convention Centre, Calgary
Chair: **George Morlidge**

Chair's Report: Future Challenges

► Membership

- Section membership continues to slowly drop.
- Challenge is to reverse this trend by showing members that IEEE is a great value proposition .

► Volunteers

- Success of IEEE is totally dependant on dedicated and passionate volunteers.
- Many Chapters & Affinity Groups have great volunteers.
- Other Chapters are basically dormant.

► Activities

- Many Chapters / Affinity Groups are very active but others are not. Challenge is to keep them all active.



Southern Alberta Section Treasurer's Report

2016 in review

Dale Tardiff

Income Statement 2016

Financial Row	Amount
Ordinary Income/Expense	
Income	
1.20 - Received from Corporations	\$3,000.00
2.10 - Meetings & Social Events	\$9,655.36
2.50 - Conference Revenue	\$4,000.00
2.60 - Educational Activities	\$57,200.72
3.10 - Rebate from IEEE HQ	\$11,305.34
3.30 - Sections or Councils	\$6,788.35
3.34 - IEEE HQ & Societies	\$14,490.90
3.40 - IEEE CB Account Interest	\$364.68
Total - Income	\$106,805.35
Gross Profit	\$106,805.35
Expense	
4.10 - Meetings & Social Events Expense	\$24,967.47
4.50 - Conference Expenses	\$30,132.89
4.60 - Educational Activities Expense	\$41,827.33
4.70 - Professional Activities Expense	\$47.58
4.80 - Student Activities Expense	\$8,871.17
4.85 - Grants and Awards Expense	\$643.89
4.90 - Other Program Expenses	\$1,185.76
5.20 - Travel Expense	\$4,426.97
5.31 - Consultants/Freelancer Fees	\$325.00
6.10 - Postage & Supplies	\$128.81
7.00 - Reserve Allocation Expense	\$1,197.99
Total - Expense	\$113,754.86
Net Ordinary Income	-\$6,949.51
Net Income	-\$6,949.51

Balance Sheet 2016

Financial Row	Amount
ASSETS	
Current Assets	
Bank	
74379 - Custody Banking Section SOUTHERN ALBERTA	\$68,362.87
Total Bank	\$68,362.87
Other Current Asset	
90066 - GST/HST on Purchases	\$876.21
Total Other Current Asset	\$876.21
Total Current Assets	\$69,239.08
Total ASSETS	\$69,239.08
LIABILITIES & EQUITY	
Current Liabilities	
Accounts Payable	
20105 - Accounts Payable	\$480.27
Total Accounts Payable	\$480.27
Total Current Liabilities	\$480.27
Long Term Liabilities	
74246 - Reserve Allocation Payable	\$34,069.75
Total Long Term Liabilities	\$34,069.75
Equity	
Retained Earnings	\$41,638.57
Net Income	-\$6,949.51
Total Equity	\$34,689.06
Total LIABILITIES & EQUITY	\$69,239.08

Investment Fund

Financial Row	Amount
ASSETS	
Current Assets	
Bank	
74658 - IEEE Long Term Investments SOUTHERN ALBERTA	\$88,468.12
Total Bank	\$88,468.12
Total Current Assets	\$88,468.12
Total ASSETS	\$88,468.12
LIABILITIES & EQUITY	
Long Term Liabilities	
74246 - Reserve Allocation Payable	\$6,777.74
Total Long Term Liabilities	\$6,777.74
Equity	
Retained Earnings	\$79,287.46
Net Income	\$2,402.92
Total Equity	\$81,690.38
Total LIABILITIES & EQUITY	\$88,468.12



Southern Alberta Joint PES/IAS Technical Chapter – Shan Pandher

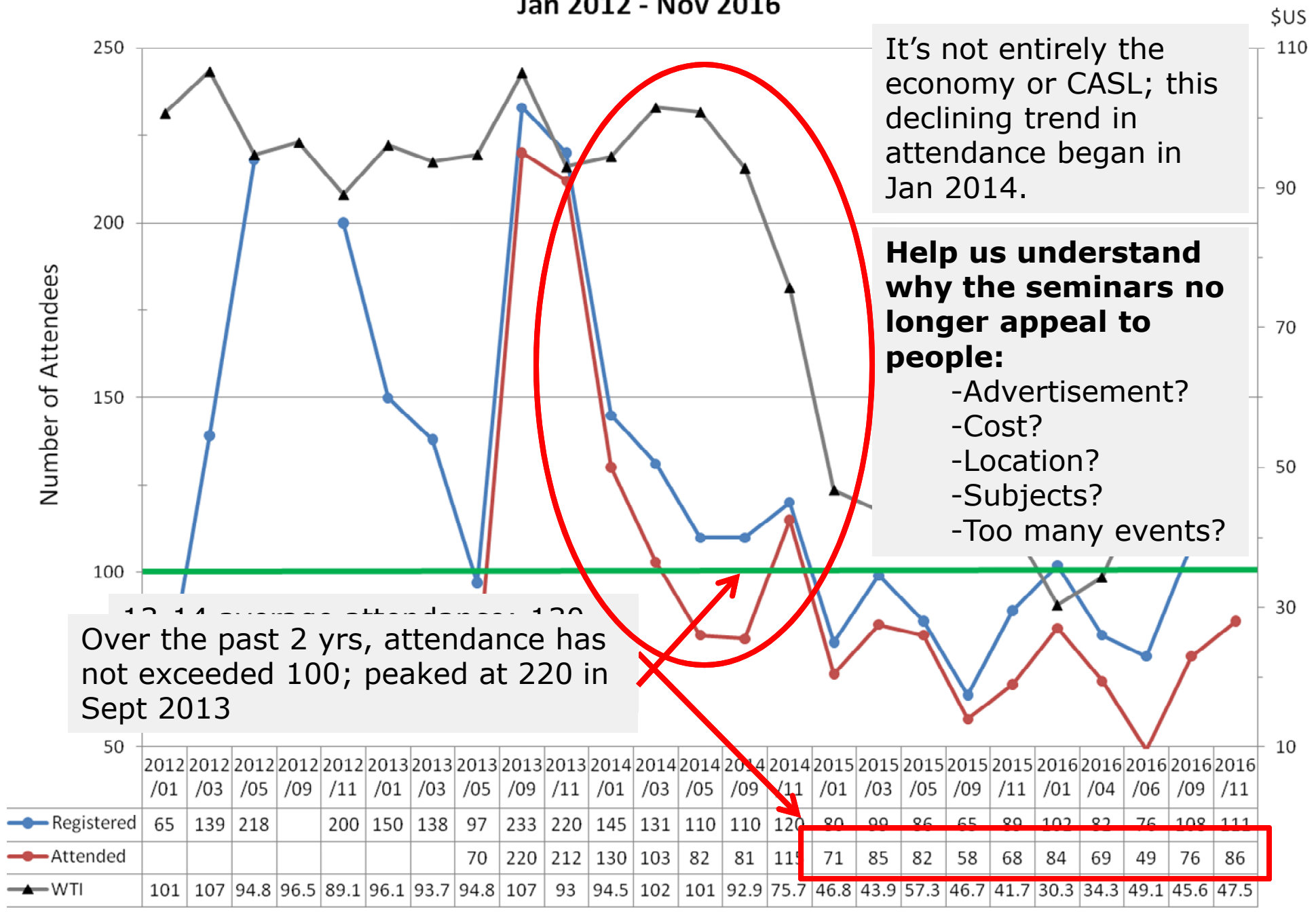
2016 in review

December 9, 2016

Held 7 technical events in 2016

Topic	Date	Presenter
Hazardous Location Standards for Canada	Jan 25	Marty Cole, SMIEEE Tim Driscoll, FIEEE George Morlidge, SMIEEE
Power Systems – Making the Right Decisions	Feb 22-23	Bill Kennedy, LSMIEEE
Designing Electrical Systems for On-Site Power Generation	Apr 4	Rich Scroggins
Partial Discharges In Electrical Insulation	June 1	Greg Stone, FIEEE
Medium Voltage Distribution	Sep 26	Carl Moller, SMIEEE
Power System Stability and Control	Oct 25-28	Prabha Kundur, LFIEEE
Protective Relays: Principles of Applications	Nov 21	Rasheek Rifaat, LFIEEE

PES/IAS Evening Seminar Attendance Jan 2012 - Nov 2016



Chapter Member Recognitions

- ▶ Chapter won the Industry Applications Society's "Continuing Outstanding Performance – Large Chapter" Award
- ▶ Fred Ritter and Ronnie Minhaz won the "Southern Alberta PES Outstanding Engineer" Awards
- ▶ 14 members of the PES/IAS Chapter were elevated to Senior Member. Congratulations to:

Roger Argenal

John Kehler

Rod McNeil

Ramaiah Divi

Jim Kulchisky

Ronnie Minhaz

Matt Eskandar

Andy Kneubuhler

Carl Moller

Lionel Gunawardhana

Ken Martyn

Joanne Phillips

Dave Hines

Pamela Mclean



Chapter Financials

▶ 2016 Budget:

- Revenues: \$ 79,100
- Costs: \$ 78,500
- Surplus: \$ 600

▶ 2016 Actual:

- Revenues: \$ 77,486 Oct 31
- Costs: \$ 71,134 Oct 31

- Revenues: \$ 78,901 est. Dec 31
- Costs: \$ 77,998 est. Dec 31
- Surplus: \$ 903 est.

2017 Program

Topic	Date	Presenters
Seminars:		
Industrial applications of co-generation	Feb 6	Mark Heigold Rasheek Rifaat Fred Ritter Brian Wagner
Motor protection (IEEE RP 3004.8)	May 15	
Grid energy storage: policies and applications	Nov 20	John Martin Mark Childerhose
Workshop:		
Industrial and distribution system applications of EMTP-ATP	Late March	Rasheek Rifaat

PCIC 2017 Technical Conference

- The flagship conference of the Industry Applications Society (IAS), with focus on electrical engineering related to the production, manufacturing and transportation of petroleum and chemical products.
- Includes technical paper presentations, tutorials, networking with colleagues, meeting vendors, and social events.
- **Date:** September 17 – 20, 2017
- **Location:** Telus Convention Centre, Calgary
- **Website:** <http://ieeepcic.com/>
- Registration opens in May 2017.
- ***We look forward to seeing you there!***



Thank you!

Website:

<http://sas.ieee.ca/pesias>

LinkedIn Group:

“Southern Alberta PES/IAS Chapter”

Chapter Chair:

Dave Hines (davehines@ieee.org)



Southern Alberta Computer Chapter Report - Mohammad Moshirpour

2016 in review

Symposiums

› **Symposium on Information Security**

- Event Goals:
 - To provide an opportunity for expanding security knowledge for everyone such that individuals and organizations can make informed decisions about true security risks and solutions.
 - To discuss current trends in information security and current threats and defenses
- Attendance: 56 People (45 members)

› **Symposium on Big Data Management and Analytics**

- Event Goals:
 - To discuss the latest developments in big data analytics
 - To show case the approaches of different fields with regards to big data analytics
 - To bring industry and academia together and encourage more collaborations
- Attendance: 89 People (67 members)

Workshops and Technical Talks

➤ **Microsoft Talk**

- Topic: Microsoft Tools for Mac Developers
- Presenter: Sergii Baidachnyi
- Attendance: 32 People (11 members)

➤ **Microsoft Workshop**

- Topic: Microsoft Azure
- Presenter: Sergii Baidachnyi
- Attendance: 26 People (9 members)

Education

› **Software Engineering Night**

– Event Goals:

- To show case cutting-edge software engineering research and industry projects in Calgary
- To Promote software engineering and IEEE Computer Chapter SAS

– Attendance: 86 People (11 members)

› **Project Demonstrations**

– Event Goals:

- To promote a local collaborative community for software developers in different levels
- To facilitate idea sharing, networking, and to offer mentorship

– Attendance: 42 People (7 members)

Education Cont'd

➤ **Engineering and Computing Education Talk and Panel Discussion**

- Speaker: Dr. Rob Reilly
- Event Goals:
 - To discuss effective use of technology in teaching electrical, computer and software engineering
 - To share teaching experiences, and discuss existing challenges and possible solutions in teaching
- Attendance: 36 People (25 members)



Southern Alberta Antennas and Propagation (AP03)/ Microwave Theory and Techniques (MTT17)/ Communications (COM19) Joint Chapter Report – Dr. Mohamed Helaoui

2016 in review

Southern Alberta COM/MTT/AP Joint Chapter

► 2016 Events

- MTT talk (~ 30 attendees)

Dr. Madu S. Gupta (DML and IEEE Fellow), from University of California at San Diego “Microwave Engineering: What is it, Where is it Headed, and How it Serves Mankind,” May 19, 2016

- COM talk (~ 20 attendees)

Prof. Norman C. Beaulieu (IEEE Fellow, Fellow of the Royal Society of Canada), from Beijing University of Posts and Telecommunications “The Fundamental Form of the Cramér-Rao Bound,” October 31, 2016

Southern Alberta COM/MTT/AP Joint Chapter

► Plan for 2017 Events

- 1 MTT talk
- 1 COM talk
- 1 AP talk



Southern Alberta Engineering in Medicine and Biology (EMBS) Chapter Report – Lawrence Whitby

2016 in review

Summary

2 EMBS Events:

June 7, 2016

Computer Aided Systems for Burn Assessment – Begona Acha, Ph.D., Signal Processing and Communications Department, University of Seville, Spain. Attended by 12 people.

June 8, 2016

Image Processing Techniques For Analysis of Pigmented Lesions – Carmen Serrano, Ph.D., Signal Processing and Communications Department, University of Seville, Spain. Attended by 19 people.

2016 Biomedical Engineering Industry Partnership Day

November 25, 2016

9:00 a.m. – 4:00 p.m.

Speakers:

Dr. Breanne Everett, Orpyx Medical Technologies.

Peter Fenwick, Social Entrepreneur and Business
Executive



University of Calgary Student Branch Report – Samrat Kooner

2016 in review

Past Events

Jan 2016 - June 2016

- Pason System Corp Talk and Tour
- TransAlta and Minhas Brewery Tour in collaboration with University of Alberta Student Branch
- WestJet Hangar Tour
- IEEE Minibots in collaboration with Robotics and Automation Chapter
- Career Fair in collaboration with ZOO
- IAS/PES Industry Panel
- IEEE PES, T&D Conference in Dallas, Texas

Past Events

September 2016 – December 2016

- Electrical Engineering 2nd Year Info Day
- Google Hackathon and talk
- IEEE DAY BBQ
- Pason System Corp Talk and Tour
- Chip Design Talk – Semteck Canada Inc
- NovAtel Internship Talk
- ENMAX Power Plant Tour
- WestJet Hanger Tour
- PES Industry Mixer

Upcoming Events

January 2017 – May 2017 Upcoming Events

- YYC New Terminal Tour
- Programming Competition by the Computer chapter
- Robotics Competition
- MPG/EIE Competition

May 2017 – June 2017 Possible Upcoming Events

- IEEE - PES Conference on Electrical Machines and Drives

Initiatives & Awards

McNaughton Learning Centre

- Proposal to be submitted to Dean's Office

Awards

- 3rd Best Student Branch Website



Southern Alberta Special Interest Group on Humanitarian Technology & Young Professionals Report – Anis ben Arfi

2016 in review

IEEE SIGHT

Special Interest Group on
Humanitarian Technology



IEEE
youngprofessionals



IEEE SIGHT

Special Interest Group on
Humanitarian Technology



IEEE
youngprofessionals

Anis Ben Arfi



IEEE SIGHT

Special Interest Group on
Humanitarian Technology

Tushar Sharma



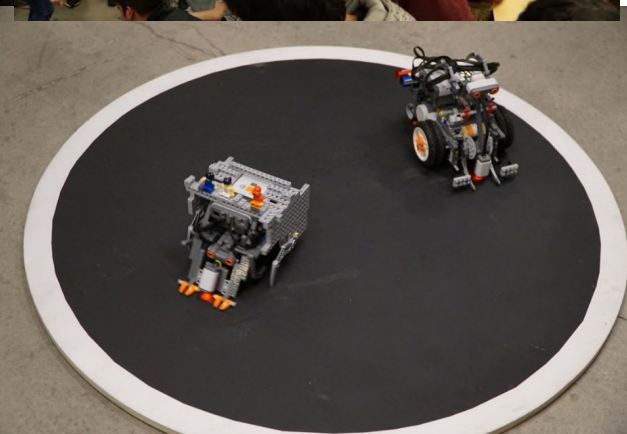
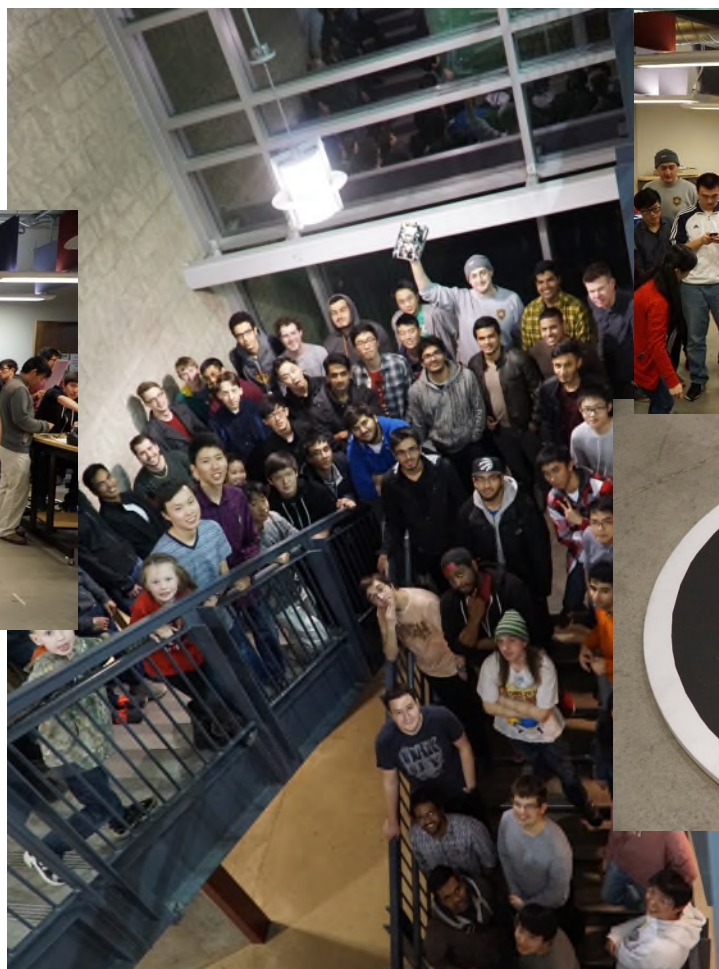
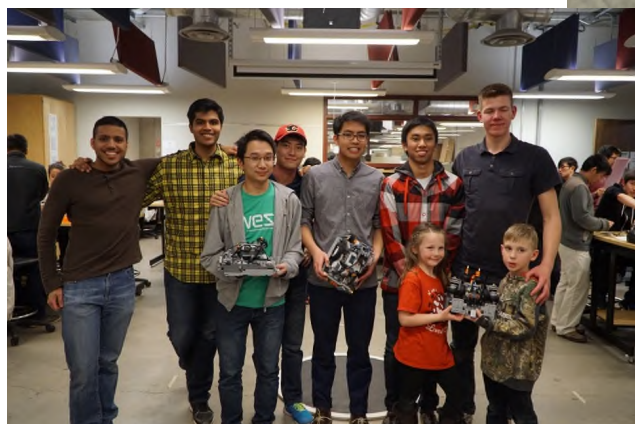
IEEE
youngprofessionals





Sumo robotics competition

60 Participants



RFID technology Talk By Glen Kathler

RFID Innovation and Applications in the Spotlight in Southern Alberta



Radio frequency identification tags are putting products in emerging markets online, enhancing fields such as emergency services livestock, oil and gas, construction, and manufacturing, healthcare, and non-profit logistics, according to Glen Kathler, director of the Southern Alberta Institute of Technology's RFID Application Development Lab.

RFID tags improve processes and track assets, including clothing and medical devices, Kathler says. Kathler made the remarks in a talk called Radio Frequency Identification: Innovation and Applications at an event hosted by IEEE SIGHT Southern Alberta.

- Anis Ben Arfi and Martin Berka, IEEE SIGHT
Southern Alberta



21 Attendees



IEEE SIGHT

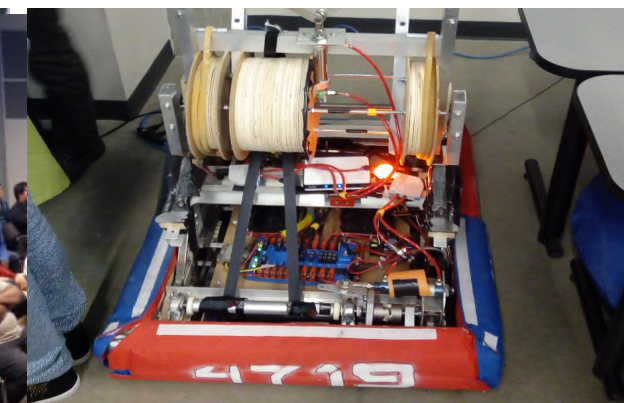
Special Interest Group on
Humanitarian Technology



IEEE
youngprofessionals

Meet My Robot exhibit

80
Attendees



Participation in Capstone projects



4 Teams



IEEE SIGHT

Special Interest Group on
Humanitarian Technology



IEEE
youngprofessionals

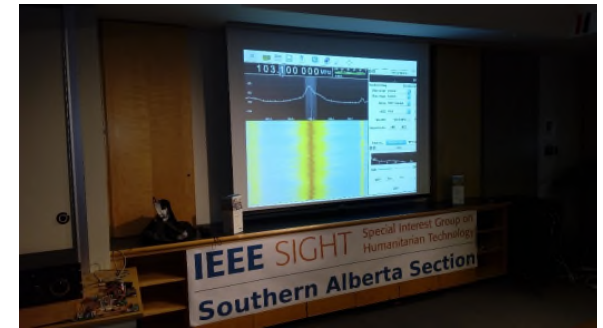
Annual BBQ – IEEE DAY Celebration



300 Participants



Amateur Radio Training



Participants 30

Tikkun Olam Makers Makeathon



80 Participants



Community engagement workshop



Participants 24

IEEE SIGHT

Special Interest Group on
Humanitarian Technology



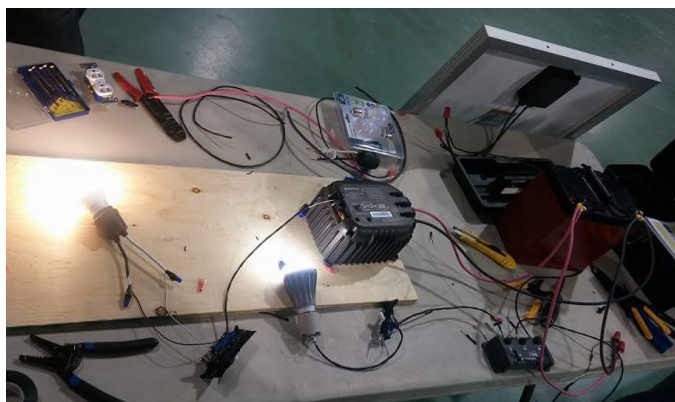
IEEE
youngprofessionals

SikSika Nation Reserve visit



Training by Light Up The World

12 Participants



IEEE SIGHT

Special Interest Group on
Humanitarian Technology



IEEE
youngprofessionals

Thank you!





Southern Alberta Women in Engineering (WIE) Report – Dr. Laleh Behjat

2016 in review

Women in Engineering (WIE) Report



Women in Engineering (WIE) Report

STUDENT ACTIVITIES

Women in Engineering (WIE) Report



Grace Hopper Conference

Women in Engineering (WIE) Report

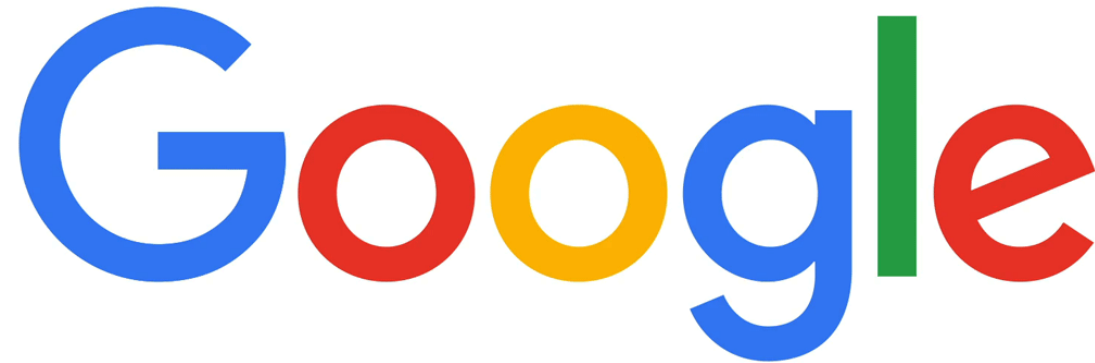


WIE Night

Women in Engineering (WIE) Report

INVOLVEMENT WITH OTHER PROFESSIONAL GROUPS

Women in Engineering (WIE) Report



CODERETREAT

- Code retreat
- Workshops
 - interview/resume prep
 - growing your skills

Women in Engineering (WIE) Report

- Students:
 - Engineering Expo
 - Women in Engineering conference
 - Associate Dean Diversity
- Workshops on leadership
- Book club



Southern Alberta Section – 2016 Awards

Southern Alberta Section – 2016 Awards

- ▶ IEEE Power Engineering Society
Outstanding Engineer Awards
 - Less than 15 years: **Ronnie Minhaz,
P.Eng.**
 - Greater than 15 years: **Fred Ritter,
P.Eng.**

Southern Alberta Section – 2016 Awards

- ▶ IEEE Power Engineering Society
Scholarship Awards
 - **Yilin (Linda) Zhao**
 - **Bill Skinner**

Southern Alberta Section – 2016 Awards

- ▶ IEEE Southern Alberta Section Scholarship Awards
 - Academics: **Yilin (Linda) Zhao**
 - Research: **Abubaker Abdelhafiz**
 - Leadership: **Anis Ben Arfi**



Southern Alberta Section – Election of Officers

Lawrence Whitby

Southern Alberta Section – Election of Officers

- Southern Alberta Section Officers for 2017 – 2018
 - Chair: Dale Tardiff
 - Past Chair: Doug Brooks
 - Vice Chair: Arman Kiani or Shan Pandher
 - Treasurer: Vivek Tadiparty
 - Secretary: Zhara Lari
 - Membership Development: Rod McNeil



UNIVERSITY OF
CALGARY



2016 Annual General Meeting of the IEEE Southern Alberta

Current Technologies and Prospects of Autonomous and Connected Vehicles

© Dr. Behrouz Far, P.Eng. (far@ucalgary.ca)

Department of Electrical and Computer Engineering
Schulich School of Engineering



- Transportation systems: Issues and solutions
- Key Technologies
- UGV 101: Let's build it!
- In Vehicle Monitoring System (IVMS): Let's do it!
- Practical Usage of Data: Let's use it!
- Current Initiatives

- **Safety issues:**

- Approximately 1.2 million people are killed on the world's roads -- about 2,000 in Canada -- each year
- Approximately 95% of collisions (accidents) are caused by human error

- **Productivity and Economy issues:**

- Congestion on average >50 mins per day in North America

- **Environment issues:**

- Air pollution in urban centers due to road vehicles



Or

Connected
Autonomous
Electric
Vehicles
Technology

Safety	ok
Environment	ok
Productivity	ng

■ CAE: **C**onnected – **A**utonomous – **E**lectric Vehicles

Potential benefits:

Safer

More efficient transport

More environment friendly **sses**

will benefit –or– will be impacted
sooner, rather than later



Potential impacts:

Disruption

Loss of jobs and resources

Autonomous Ground Vehicles (AGVs)

- Autonomous ground vehicles (AGVs):
 - unmanned ground vehicles (UGVs) and
 - intelligent transport systems (ITSs)
- UGVs: autonomous, self-driving, driverless vehicles
- ITSs: connected vehicles

30+ corporations are working on UGVs, from automobile manufacturers to tech leading companies and everything in between

Unmanned Ground Vehicles (UGVs)

- Full autonomous driving with **G**uidance, **N**avigation and **C**ontrol (GNC) system
- Reduce current annual road fatalities in Canada by 1,600 a year
- Total economic benefit: \$42 billion by 2025 and \$77 billion by 2035
- Several manufacturers expect to have automated UGVs by 2020–25

Intelligent Transport Systems (ITSs)

- Already appearing as pilot projects
- System elements:
 - In Vehicle Monitoring System (IVMS)
 - Road Side Units (RSU)
 - Variable Message Signs (VMS)
- Typical Architecture:
 - Vehicle to vehicle (V2V)
 - Vehicle to vehicle (V2V)
 - Vehicle to anything else (V2X)



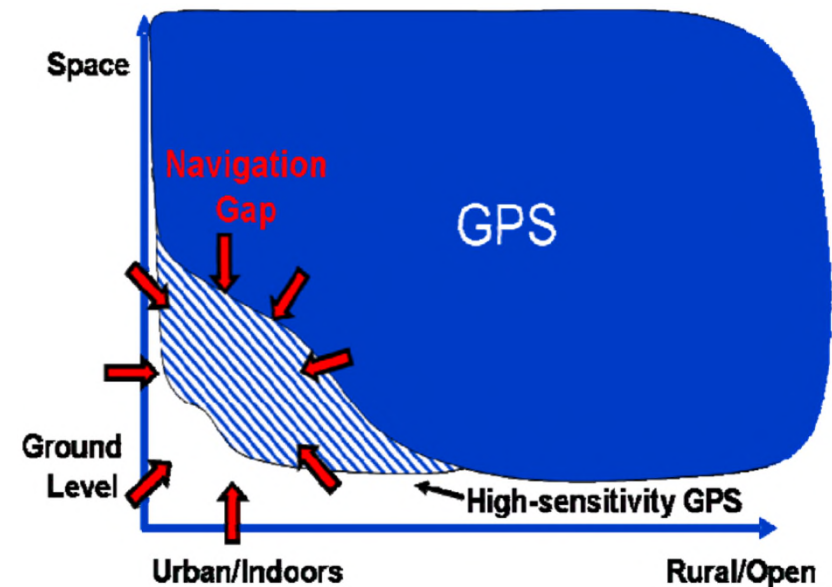
Benefits:

Improve safety
Reduce congestion
Environment friendly
Enhance traveler services

- Sensor technology
 - Navigation technology
 - Algorithms (e.g. control, guidance)
 - Data technology
 - Software (e.g. services) technology
 - Computing infrastructure (e.g. cluster, cloud)
- Technologies exist since 1970s.
 - Combination of the technologies is the key

1. Sensor Technology

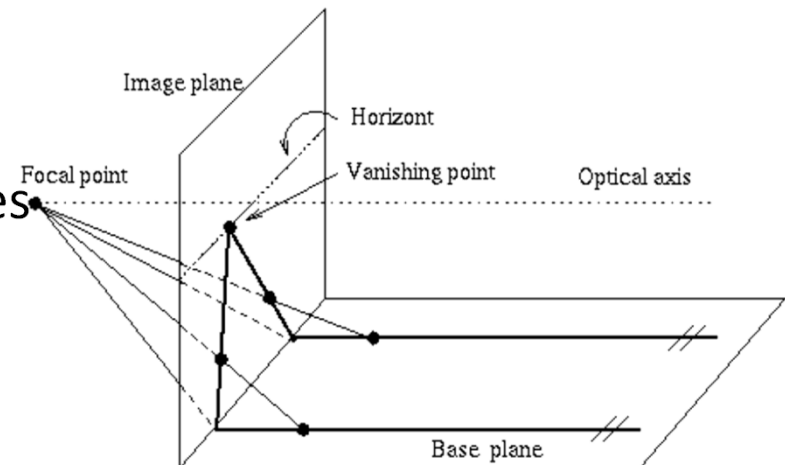
- **Passive:** IMU, GNSS receiver, odometer, camera
- **Active:** Laser scanner or LiDAR, Radar
- **Virtual Sensor:** motion constraints (Vision sensor aided navigation for AGVs)



1500+ sensors in modern automobiles

2. Navigation Technology

- Non-visual navigation system
- Visual-Inertial Navigation System (VINS)
 - Vision-based motion estimation
 - Using computer vision technology:
 - Stereo-vision
 - Pattern recognition
 - Tracking and matching features
 - etc.



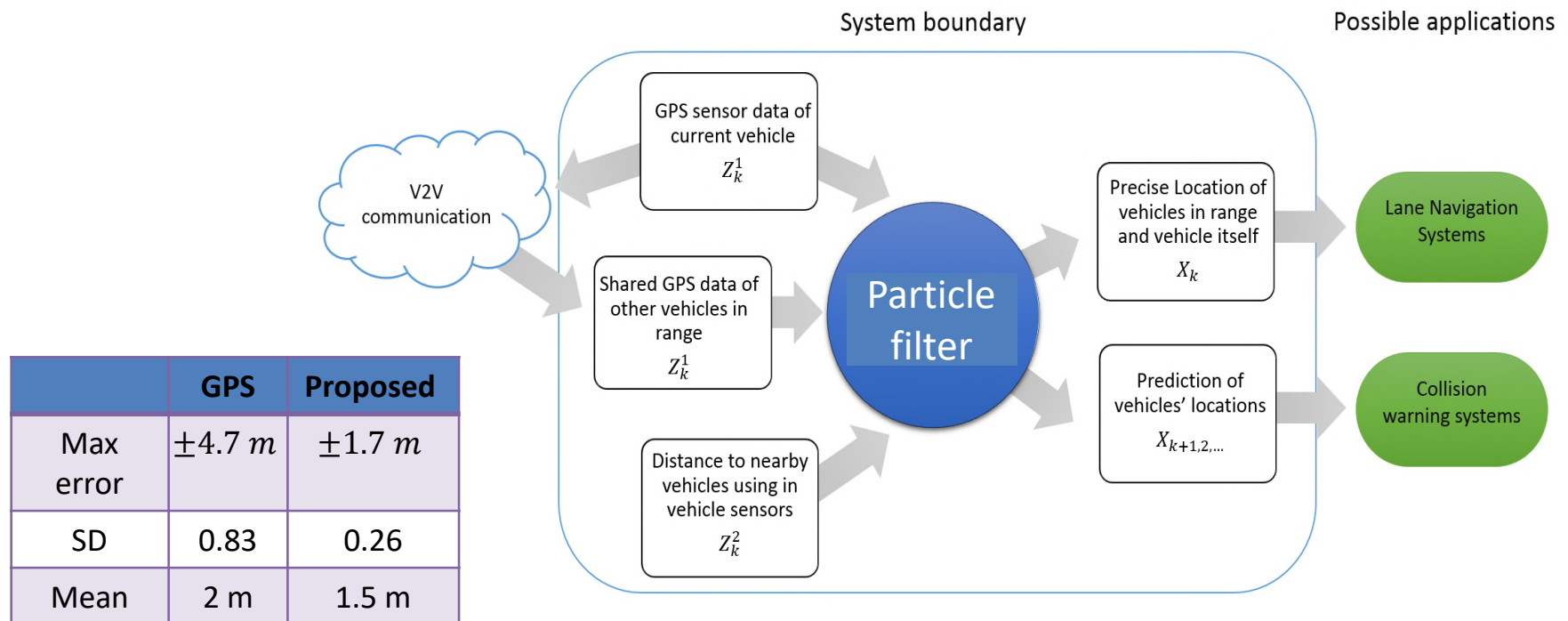
3. Algorithms

- Many algorithms for localization, guidance, navigation and control
- Cooperative multi-sensor multi-vehicle localization
- Loosely coupled vs. tightly coupled VINS
- Estimation/filtering technology: Kalman filter, Probability Hypothesis Density (PHD) filter, etc.



Example: Multi-Target Localization

- Decentralized PHD filtering algorithm run on each vehicle



- Structured and unstructured data
- Key storage requirements: ability to handle **large** amounts of data and keep **scaling** to keep up with growth; **performance**; high **availability**; data **security**; demand-based **deployment**; **resiliency**; **management** and monitoring

Unmanaged Resources

- Last level cache
- Memory channels
- Network devices

unmanaged resources are the source of performance interference and degradation

Managed Resources

- CPU
- Memory
- I/O devices

5. Software Technology

- Artificial Intelligence: machine learning (e.g. clustering, collaborative filtering)
- Multi-agent systems
- Personalized ITS solutions: monitoring and warning systems, recommendation systems
- Combination of **sensory information** + **real time navigation** + **AI technology** = safer & more efficient road transportation today (on **existing** infrastructure)

- Real time navigation, monitoring and warning systems
 - Monitor and detect pedestrians on blind left turns; blind merge warning; curve speed warning; rollover warning; emergency vehicle traffic signal pre-emption;
 - highway/rail collision warning; intersection collision warning (rear end or vehicle running a red light); vehicle-based road condition warning; wrong way driver warning;
 - stop sign violation warning; traffic signal violation warning and work zone warning



6. Computing infrastructure

- Key computing requirements: ability to handle **large** amounts of data; ability to provide the **input/output** operations per second (IOPS) necessary to deliver results with low latency
- Parallel processing capabilities; more VMs per core; virtualization capabilities; modular systems design; elastic scaling capacity; enhancements for security and compliance and hardware-assisted encryption; increased memory and processor utilization
- Do we need dedicated hardware?
- How to setup your own physical private cluster?
- Virtualization and cloud migration solutions?

High-performance computing (HPC) system is not suitable for various forms of unstructured data

- Building blocks of Hadoop cluster
- In the cluster we have a few machines act as **Name node** and **JobTracker** collectively called Masters
- Master nodes typically require more memory and CPU power and less disk space



<http://saphanatutorial.com/hadoop-cluster-architecture-and-core-components/>

- Multi-core (single or multi-thread) high performance processor, e.g. Intel Xeon
- 2 or 4 hot swap HDD/SDD per node
- Minimum 8 Gbyte of RAM
- 2 hot swap PSUs
- On Board IPMI Remote Management
- High efficiency dual network connectivity
- Linux operating system (mostly)



Do we need CPU-GPU pair?

Can I Build a Cluster from Scratch?

- Yes!
- What type you want? There are many ...
 - High availability cluster?
 - Load balancing cluster?
 - High throughput cluster?
 - High performance cluster?
- You can build
 - a physical cluster from scratch with simple computers -- or--
 - a virtual cluster on a more powerful computer --or--
 - a virtual cluster on the cloud

Which cluster type better suits my case?
QoS (mainly, response time and throughput) should match computation and I/O needs

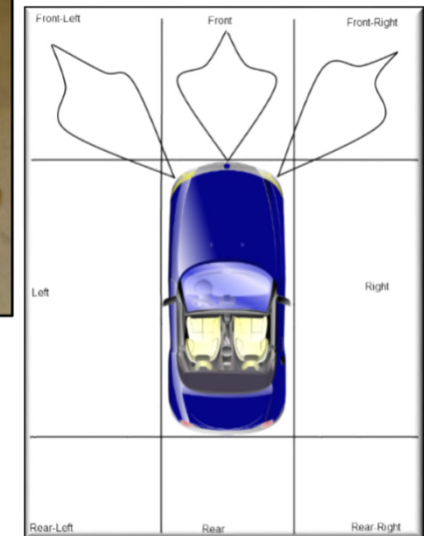
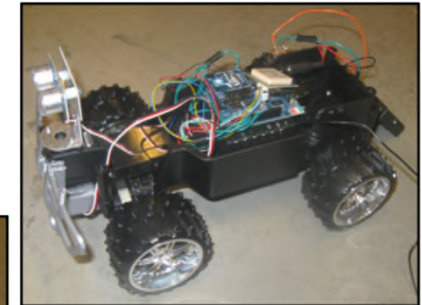
UGV 101: Let's build it!

- Select a platform
- Add physical hardware: sensors (perception, positioning); computing; storage devices
- Add data fusion mechanisms: PolySync, etc.
- Add Guidance, Navigation and Control (GNC) algorithms

Hardware

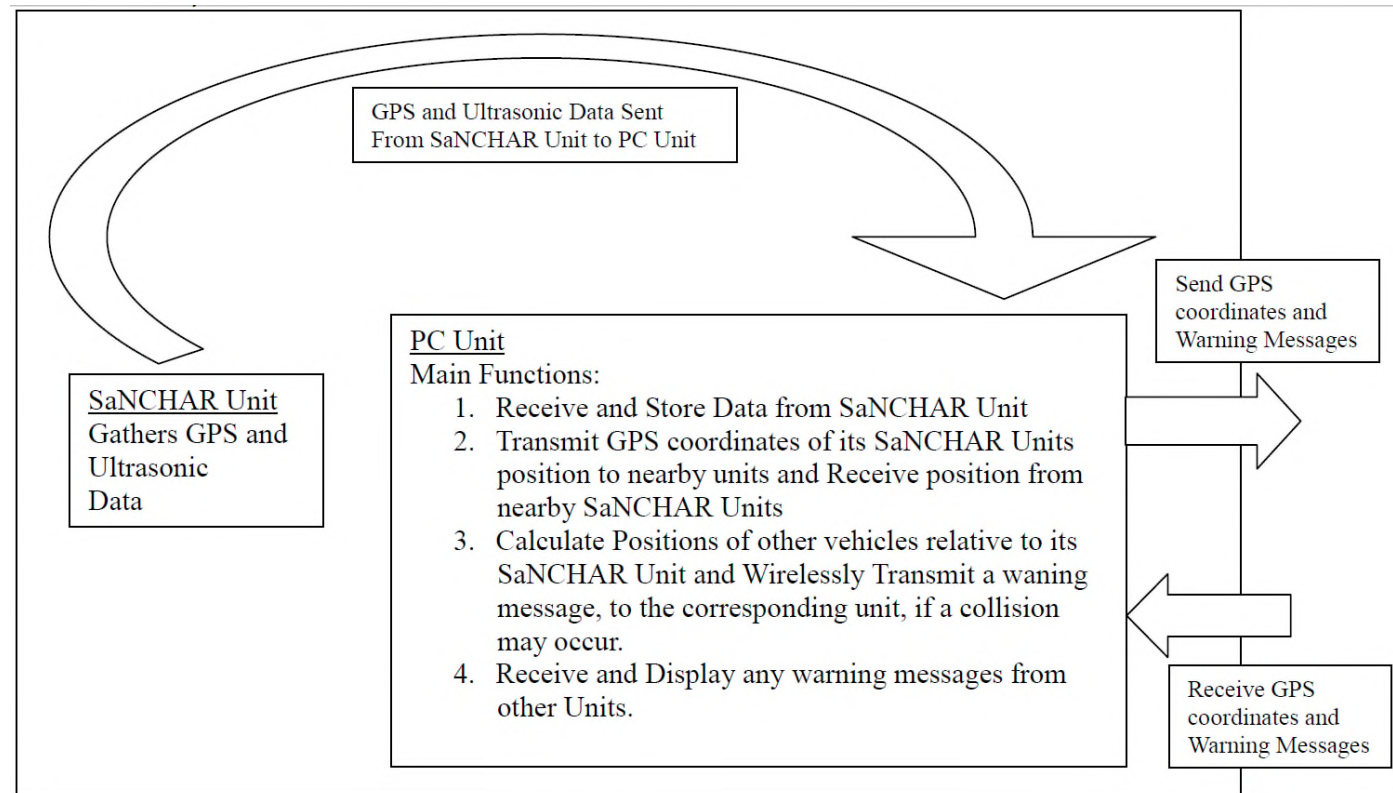
software

- Platform: remote controlled toy car
- Physical hardware: GPS and Ultrasonic sensors
 - Controller: Arduino board
 - Sensor :Parallax's PING)))™ ultrasonic sensor
 - Wireless Unit: Xbee® 802.15.4 wireless adaptor
 - GPS: Tyco A-1037 A GPS module



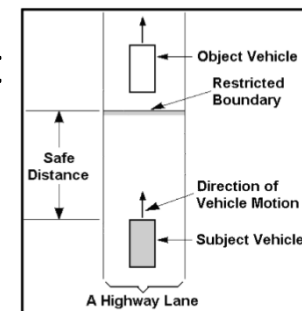
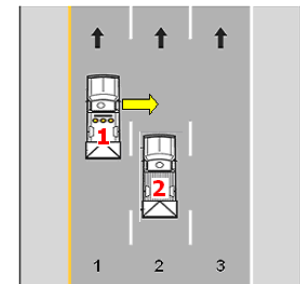


■ Simple navigation algorithm



■ Several test scenarios

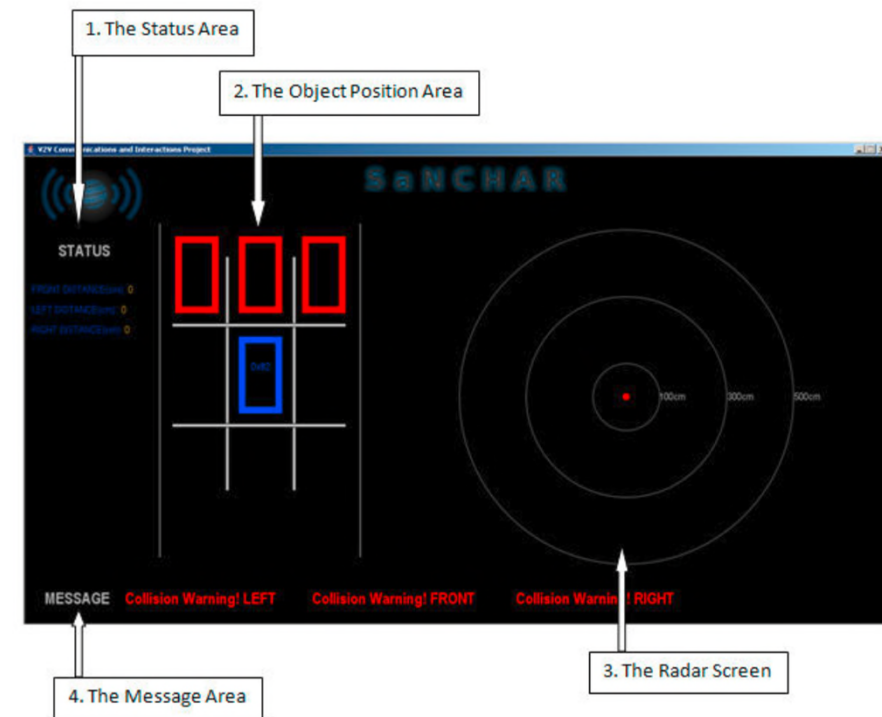
- Car 1 is in the first lane, and is 135° in front of the left side of Car 2. Car 1 is changing to the second lane, which car 2 is located in.
- Car 2 is in the second lane. Car 1 is in the first lane, and is -135° at the left side of Car 2. Car 1 is changing into the second lane.
- Car 1, 2 and 3 are in the same lane. Car 1 is in front of Car 2, and Car 3 is at the back of Car 2. Both Car 1 and 3 are speeding up. Car 2 is at a constant speed.



■ No collision for all scenarios at various speeds

GUI

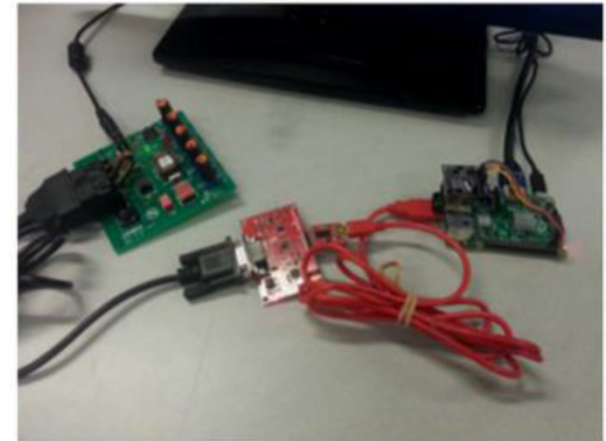
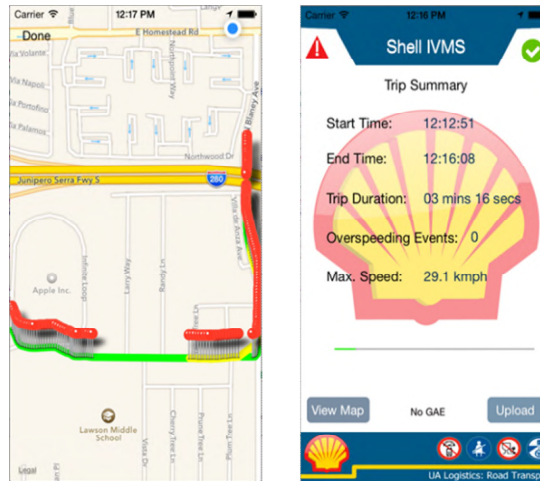
- Status area is used to display the measured distances of the ultrasonic sensor on the unit
- Object Position Area is where objects surrounding the vehicle are displayed
- Radar Screen displays the distances measured by the ultrasonic sensor in a radar style screen



In Vehicle Monitoring System

IVMS: Let's do it!

- IVMS that collects info from the car and drivers' cell phone; sends it to a repository; has Web and App interface
- Developing an iOS driver monitoring app for Shell



- Developed a new IVMS using Raspberry Pie

Practical Usage of Data: Let's use it!

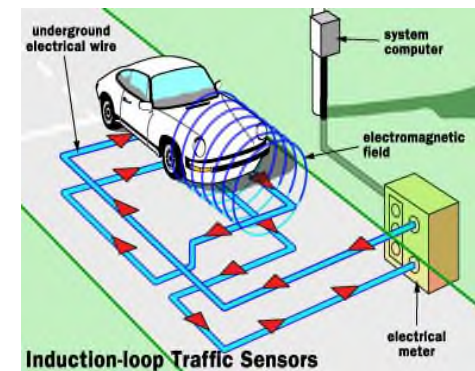
■ **Case Study:** Vehicle's Commute Time Prediction

1. Where is data?
2. How to collect data?
3. How to extract meaningful info from data?
4. How to use meaningful info in ...?



1. Where is Data?

- Data typically collected from sensors and cameras
- Needs dedicated infrastructure
 - Specialized sensors and analytics platforms
- May be difficult to customize
 - E.g., analyzing new routes
- **Alternatives?**



1. Where is Data: Web Mining

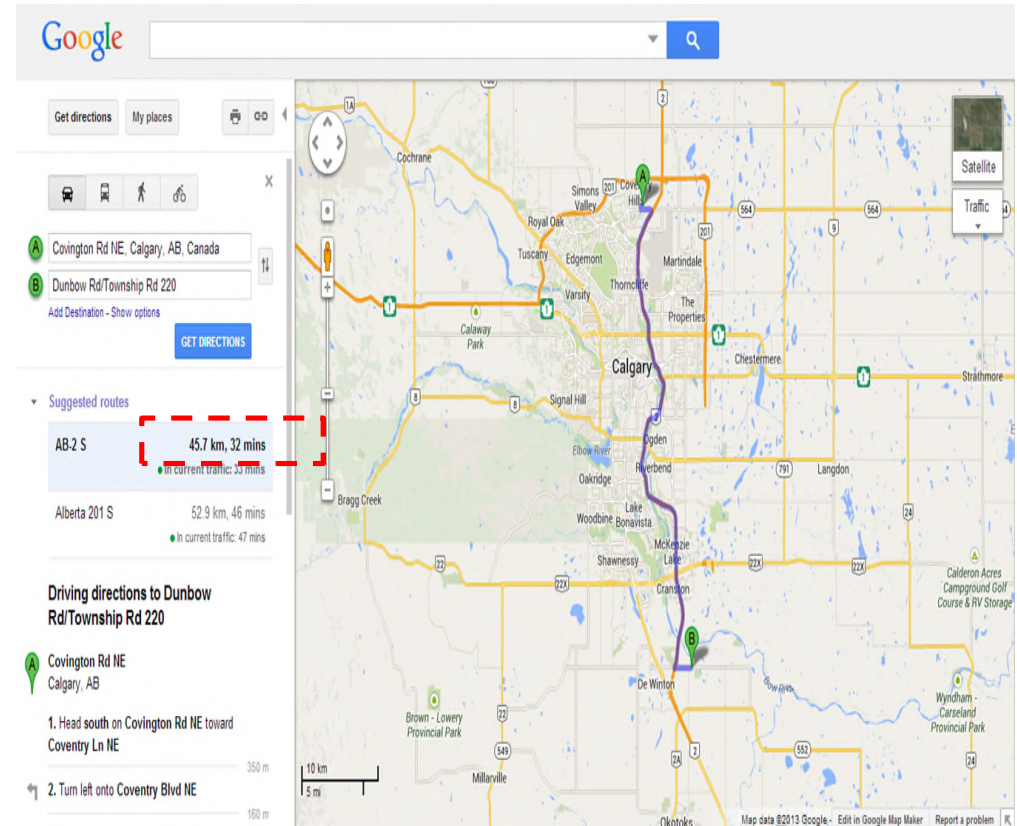
- Factors which influence commute time
 - Time of the day
 - Accidents
 - Weather
 - Etc.
- ← Google Maps
- ← Twitter, etc.
- ← Environment Canada

2. How to Collect Data?

- Data is gathered from the following sources:
 - Google Maps API and Web interface
 - Twitter and QR 660 accident tweets
 - Environment Canada annual reports

2. How to Collect Data: Web Mining

- Google Maps
 - API
 - Route Information
 - One time query
 - Website
 - Commute time



2. How to Collect Data: Case Study

- **Deerfoot Trail**
 - Major highway of the city
 - To analyze the traffic behavior and problems
- 50 KMs highway and 6 sub-segments comprising at least 3 intersections
- Historical data collected for 202 days

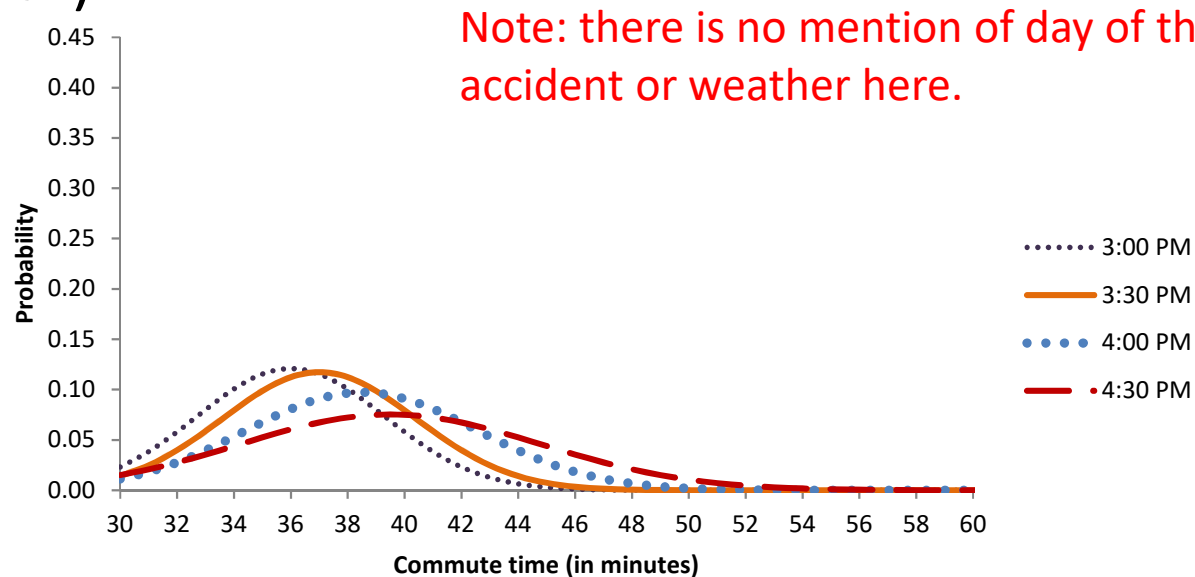
3. How to extract info from data: Statistics

- **Sample data set statistics:** Deerfoot Trail - afternoon hours (north to south)

	3:00 PM	3:30 PM	4:00 PM	4:30 PM	5:00 PM	5:30 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM
Maximum	124	75	79	89	97	105	76	58	87	68
Minimum	33	33	33	33	33	33	33	33	33	33
Mean	37	38	40	41	42	40	38	36	36	35
Median	36	37	38.5	39.5	40	39	36	35	35	35
Absolute Deviation	3.3	3.4	4.1	5.3	5.7	4.7	2.9	1.3	1.4	1
Standard Deviation	8.9	6	5.9	7.7	8.6	8.4	5	2.5	4.4	2.8
95th Percentile	43	46	48	52	55	49	44	40	37	37

3. How to extract info from data: Statistics

- **Sample data set statistics:** Deerfoot Trail - Probability distribution of commute times at afternoon hours (north to south)



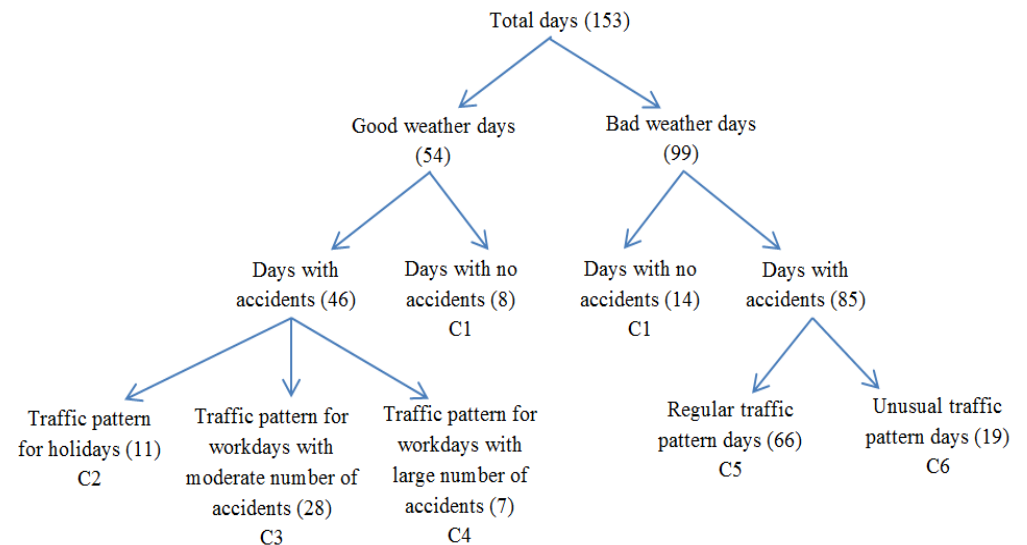
4. How to use meaningful info in ...?

- **Query:** “What is expected travel time Deerfoot Trail south bound at 4PM Friday on a snowy day?”
- **Answer:** we don’t know!
 - All we know is that it takes 39min with probability of 10%
 - It takes maximum 79min and minimum 33min any day

**Therefore, statistics may not be enough.
What else can be done to extract meaningful info?**

3. How to extract info from data: Clustering

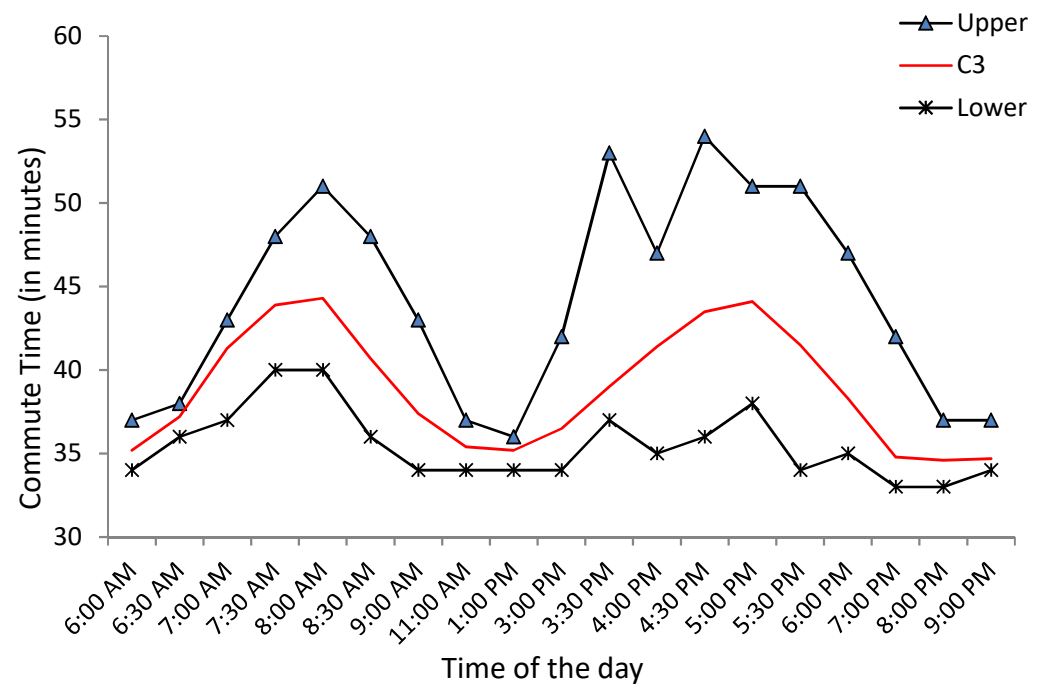
- **Clustering results: 6 unique commute time patterns**



- **Diverse weather scenarios**
 - Good weather days: days with no snow falling
 - Bad weather days: days with snow falling or snow on ground

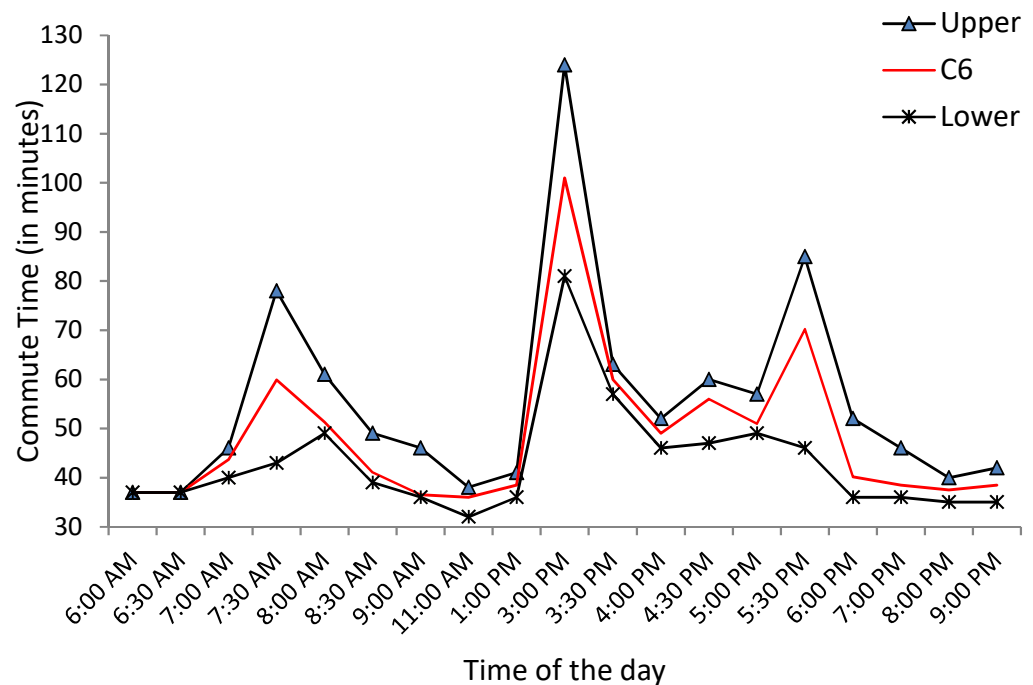
Clustering: Regular Commute Time Pattern

- **C3:** Good days with moderate accidents
- 61% of good days with accidents
- Good for predicting commute times



Clustering: Irregular Commute Time Pattern

- **C6:** Bad days with large number of accidents and severe weather conditions
- 22% of bad days with accidents
- Not so good for predicting commute times

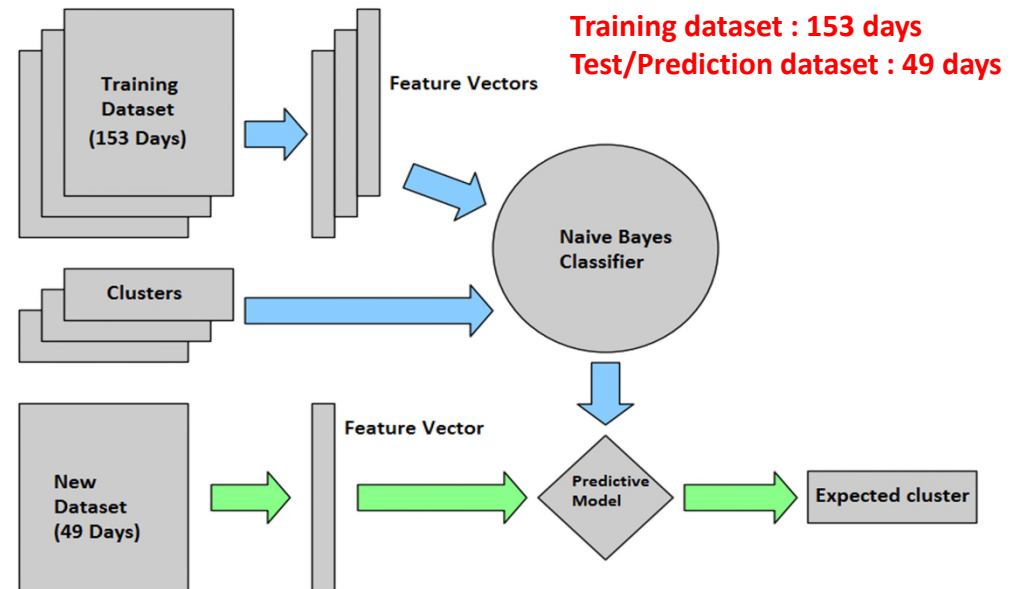
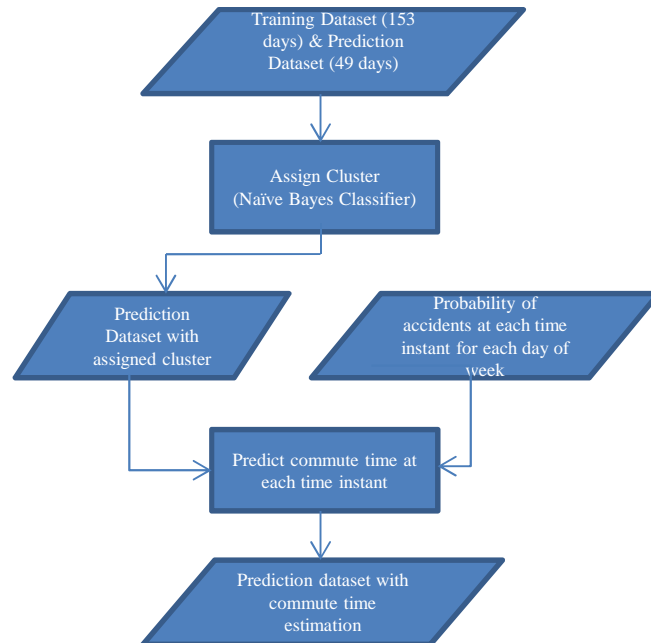


4. How to use meaningful info in ...?

- **Query:** “What is expected travel time Deerfoot Trail south bound at 4PM Friday on a snowy day?”
- **Answer:** we still don’t know!
 - We can select a pattern (C1 to C6) and combine it with the probability of accident and weather and time of day
- **How:** using classifiers

4. How to use meaningful info in ...?

- **Query:** “What is expected travel time Deerfoot Trail south bound at 4PM Friday on a snowy day?”



- Developing a location-based recommendation system
- Developing an embedded real time blink detection system for fatigue monitoring
- Implementing the Holt–Winters additive and multiplicative forecasting model with both simple moving average and exponential smoothing
- Investigating real-time connected eco-signal control system
- Etc.

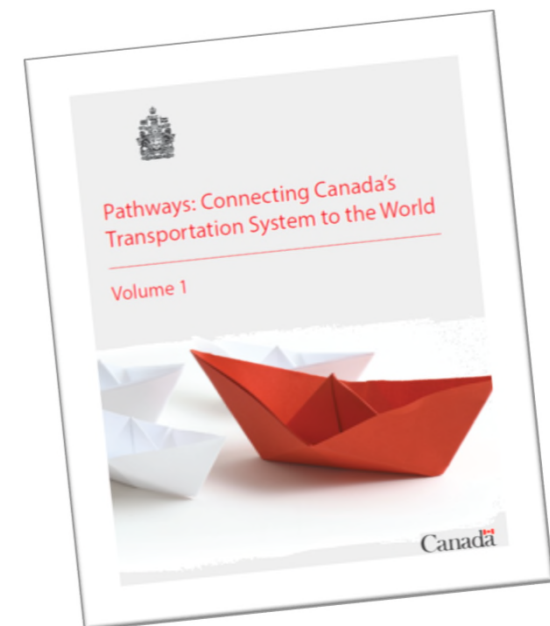
Current Initiatives

Around the World: Governmental Initiatives

- European Union (EU)'s CityMobil2 program: *Assessing the Impact of Automated Road Transport Systems*
- Canada's Emerson Report

Innovation:

	Canada 2014 Rankings
Availability of latest technologies	11
Capacity for Innovation	23
Quality of Scientific Research Institutions	18
Company spending on R&D	26
University-industry collaboration in R&D	19
Government procurement of advanced technology products	55
Availability of scientists and engineers	10



Transportation Data:

- In Canada, the lack of sufficient data or common performance metrics makes it extremely difficult to analyze, forecast, or plan for efficient use of the system.
- At the same time, a new cohort is entering the transportation and logistics workforce, with a profoundly different perspective on how information and technology can be applied to tackle pervasive issues in ways that may be unimaginable today.
- Better information will support improved oversight and enforcement, and it is our recommendation that the Canadian Transportation Agency be mandated as the custodian of transportation data, with resources to collect, analyze and publish more accurate, comprehensive, and timely transportation data to provide effective oversight and enforcement.

Around the World: Commercial Initiatives

- Google electric, automated, low-speed (40 kph), two-seater vehicle
- General Motors' super cruise technology (2017 ~)
- Toyota's Safety First technology (2013 ~)
- Navya Technologies' Navya, a fully automated shuttle vehicle for campuses, airports, etc.
- Milton Keynes' Electric Automated Taxi
- UK's driverless taxi "pod" (2015~)
- Tokyo Olympics (2020)



Transportation-As-A-Service (TaaS)

- More effective ride-sharing: low-cost, door-to-door service
 - Use of vehicles on a short-term rental basis as an alternative to ownership
- Disruption: conflicts with existing business models of taxi, car-rental and car-share services
- Impact on: infrastructure and economy

- Free up 5 billion hours per year to be used on productive or leisure activities
- AGV is estimated to remove up to 48% of all collisions
- AGV can significantly reduce the number of vehicle collisions caused by human error
- AGV can potentially to reduce congestion on our roads, as well as reduce the amount of fuel that we consume
- The sum of these benefits could be in order of tens of billion per year



Automated Vehicles: The Coming of the Next Disruptive Technology
Paul Godsmark, Barrie Kirk, Vijay Gill, and Brian Flemming

- AGVs will bring about infrastructure needs different from the current infrastructure, e.g. maximizes road capacity by reducing gaps, improving flows, minimize road geometry
 - Rethink infrastructure investment
 - Major transportation infrastructure investments are typically planned with 30-year time span
 - What will be impacts on the investment needs?
- AGVs will affect public transport drastically
- AGVs will make shared fleets more attractive and it may have a large impact on the rate of individual car ownership

- Driver's licenses no longer required?
- Traffic law enforcement no longer required?
- Vehicle Insurance eliminated?
- Potential disruption for more than 500,000 Canadians who currently earn their living driving a vehicle?

- Autonomous vehicles
- Alternate delivery methods (e.g. drones)
- Alternate vehicle fuels and electrical charging systems
- Connected vehicles
- Alternate public transit provisions
- Alternate parking and curbside management strategies
- Open data and development of apps
- Alternate payment mechanisms



Are we prepared for this **paradigm shift?**