"Motor Show" will really become a show of a motor!

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Abstract

Electric vehicle (EV) is the most exciting object to apply "advanced motion control" technique. As an EV is driven by electric motors, it has the three remarkable advantages: 1) motor torque generation is fast and accurate; 2) motors can be installed in two or four or more wheels; and 3) motor torque can be known precisely. These advantages enable us to easily realize: 1) high performance antilock braking system and traction control system with minor feedback control at each wheel; 2) chassis motion control like direct yaw control; and 3) estimation of road surface condition.

Is EV Energy Efficient ?

Recently, pure electric vehicles (PEVs) have achieved sufficient driving performance thanks to drastic improvements in motors and batteries. It is often said that hybrid EVs (HEVs), like the Toyota Prius, will be widely used in the next ten years. On the other hand, Fuel-cell vehicles (FCVs) may be the major vehicles in the 21st century.

Such development was based on the strong incentives of energy efficiency and global environmental protection. However, it is not well recognized that the most distinct advantage of the EV is the quick and precise torque generation of the electric motor. If we do not utilize this merit, the EV will never be used in the future. For example, if a diesel HEV is developed, its energy consumption will be extremely low. The EV cannot compete against such vehicles in terms of energy efficiency or CO2 emissions.

On the contrary, if we recognize the advantage of the EV in control performance and succeed in the development of new concept vehicles, a bright future will be waiting for us.

ThreeAdvantages of EV

We can summarize the advantages of the EV into the following three points.

Fig.2. UOT MarchII (now working well)

1) Torque generation of an electric motor is very quick and accurate. This is the essential advantage. The electric motor's torque response is several milliseconds, 10-100 times as fast as that of the internal combustion engine or hydraulic braking system. This enables feedback control and we can change vehicle characteristics without any change in characteristics from the driver. This is exactly based on the concept of a two-degrees-of-freedom (2DOF) control system. A "Super Antilock Brake System (ABS)" will be possible. Moreover, an ABS and traction control system (TCS) can be integrated, because a motor can generate both acceleration or deceleration torques. If we can use low-drag tires, it will greatly contribute to energy saving.

2) A motor can be attached to each wheel. Small but powerful electric motors installed into each wheel can generate even the antidirectional torques on left and right wheels. Distributed motor location can enhance the performance of Vehicle Stability Control (VSC) such as Direct Yaw Control (DYC). It is not permitted for an

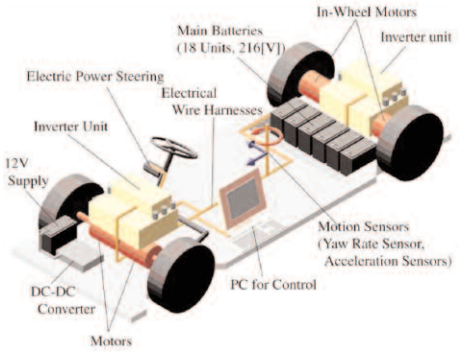

Fig.3. Structure of UOT March II

Internal Combustion engine Vehicle (ICV) to use four engines, but it is all right to use four (or eight if we want) small motors without a big cost increase. We can realize the optimal torque distribution for four tires utilizing redundancy in control inputs.

3) Motor torque can be measured easily. There is much smaller uncertainty in driving or braking torque generated by an electrical motor, compared to that of an IC engine or hydraulic brake. It can be known from the motor current. Therefore, a simple "driving force observer" can be designed and we can easily estimate the driving and braking force between tire and road surface in real time. This advantage will con

Fig.4. UOT Cadwell EV (recently completed)

tribute greatly to application of new control strategies based on road condition estimation. For example, it will be possible to alert the driver, "We have now entered a snowy road!" This also means that all running vehicles can be reliable moving realtime sensors of road condition.

What We Are Doing

These advantages of the electric motor will open the new possibility of novel vehicle motion control. In Hori Laboratory at The University of Tokyo, we made "UOT March I and II" and demonstrated these advan tages. [1]-[5] "Cadwell EV" is our third vehi cle to realize more advanced adhesion control based on the quick torque reduction characteristics of the electric motor. Recently we are making our fourth vehicle "Coms CV (Capacitor Vehicle)", which is driven only by Electric Double Layer Capacitors (EDLC), so called, Ultra-capacitors. [6][7].

Conclusions

I do not think that HEV is suitable for elegant smaller vehicles required in the future. 20 years more will be needed for FCV, which will be far in the future. Pure EV is the most realistic solution at present and hopefully also in the future. An engine will disappear in the future, and the time when all cars run by electric motors will come soon. The car companies know it very well, because they call their greatest event not "Engine Show" but "Motor Show" from an old days. At that time, "control" is the key technology.

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Fig.5. Comus CV (driven only by ultra-capacitors)

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Women in Industrial Electronics

by Mihaela Ulieru

In the male dominated world of industrial electronics a few daring and very talented women have made it to the top! They have demonstrated leadership and valuable contributions from scientific breakthroughs, inventions and innovations to industrial success. They serve as guiding lights for professional women in academia and their students - and the results have become visible. From the beginning of the Industrial Electronics Society (IES) in 1951 (in which IEEE itself has its roots!), until 1995, no woman was appointed/elected on the Administrative Committee of the IEEE Industrial Electronics Society (IES) - today we have four female IES AdCom members. Their exemplary careers and major contributions to the IES are featured in this issue of our Newsletter. Hopefully a section of the IES Newsletter will be able to honor at least one woman member in each future issue. We invite and encourage all the women members of IES to send us your profiles!

María Inés Valla *(AdCom member 2001-2004-Senior AdCom member since 2005)* got her degrees of Electronics Engineer and Doctor in Engineering from Universidad Nacional de La Plata (UNLP), Argentina in 1980 and 1994, respectively. Currently, she leads one of the few engineering research groups in Argentina that has international-level recognition. Along a 26-year career, Professor Valla has made significant contributions to Power Electronics, which may be divided between contributions to Electrical Drives and to Power Converters. She was the first woman to become Professor at the EE Department in UNLP (1992). She also was the first person to obtain a PhD degree in EE at UNLP.

All along her career Prof. Valla strived for innovation and excellence. She is involved with curricula development and university governance where she did pioneering work with the Doctorate in Engineering in Argentina. Two graduate programs she organized were accredited with the highest grade by CONEAU (Argentinean National Commission of University Evaluation and Accreditation).

She has developed several activities in the generation of scientific politics and evaluation of the scientific and technological production in Engineering. During 2005 she occupied the Chair of the Engineering Board within CONICET (National Research Council of Argentina). Also in 2004 she was member of the Committee for the selection of the winners of a National Award which recognizes the best scientific production in 4 mayor areas, she represented the area of Engineering and Agricultural Sciences.

Appart from Engineering she is quite involved in swimming. She use to compete in indoor pools as well as open water. Presently she holds 3 Argentinean Championships in the Age group 50-54: 800 m, 400m and 200m freestyle. I open water she obtain the first place for the same Age group in 3.5 Km in Areco River and Crossing of Chascomus Lagoon (4 Km).

Her involvement as volunteer of IEEE started in 1989, when she began to serve as reviewer of the Transactions on Industrial Electronics. In 1992 she participated in the creation of the Joint Chapter IES-CSS-RAS in the Argentina Section, being the Vice Chair until 1996 and the Chair of the Chapter (1997-1999). Since 1996 she has been member of different Committees like: IAS Industrial Drives Committee, CSS International Affairs Committee, CSS Women in Control Committee, IES AdCom, IEEE Ethics & Member Conduct Committee. During 2001 and 2002 she was the Vice-Chair of IEEE Argentina Section.

In 1999 she obtained the Outstanding Chapter Award of the Control System Society, in 2000 she was honored with the IEEE Third Millennium Medal; in 2002 she received the 2002 PES Chapter Outstanding Engineer Award.

Within IES she has been Coordinator of Membership Activities for Region 9 and Chair of the Student Activities Committee. She has participated in the organization of various IES related conferences.

Presently she is IES Senior AdCom Member and member of the IEEE Ethics & Member Conduct Committee.

2007 Conferences

February

DEST 2007

Inaugural IEEE – IES Digital EcoSystems and Technologies Conference
Cairns, Australia, February 21-23, 2007
http://www.ieee-dest.curtin.edu.au/

April

PCC 2007

Power Conversion Conference
Nagoya, Japan, April 02-05, 2007
http://www.ics-inc.co.jp/pcc/

May

IEMDC 2007

IEEE International Electric Machines & Drives Conference
Antalya, Turkey, May 03-05, 2007

ICM 2007

IEEE International Conference on Mechatronics
Kumamoto, Japan, May 8-10, 2007
http://www.ewh.ieee.org/soc/ies/

June

ISIE 2007

2007 IEEE International Symposium on Industrial Electronics
Vigo, Spain, June 04-07, 2007

INDIN 2007

5th IEEE Internacional Conference on Industrial Informatics
Vienna, Austria, June 27-29, 2007
http://www.indin2007

September

EPE 2007

European Power Electronics Conference
Aalborg, Denmark, September 2-5, 2007
www.epe2007.org

AIM 2007

IEEE/ASME International Conference on Advanced Intelligent Mechatronics
Zurich, Switzerland, September 04-07, 2007
http://AIM2007.ethz.ch

ETFA 2007

2007 IEEE Conference on Emerging Technologies & Factory Automation
Patras, Greece, September 18-21, 2007
http://www.etfa07.org

November

IECON 2007

33rd Annual Conference of IEEE Industrial Electronics
Taipei, Taiwan, November 06-10, 2007
http://www.ewh.ieee.org/soc/ies/