Tutorial Topic:

Will hydrogen fuel cells power next vehicle generation?
Duration of the tutorial = 2 hours

Instructor (s):

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Course Description

Fuel cell systems are promising power-generation sources that are more and more presented as a good alternative to current energy converters such as internal combustion engines. The first vehicles are available on the market. They are nevertheless scientific, technical and industrial issues that have to be tackled before seeing large fleets of such vehicles around us in day-to-day life. This tutorial will aim at presenting the current state of the art on this technology and its application in an increased electrical mobility framework. The tutorial will be decomposed in 3 parts:

1. a first one to recall the main characteristics of hydrogen fuel cells, of fuel cell systems, and to present their current performances;
2. a second one to depict the state of the art regarding fuel cell applications onboard vehicles;
3. a last one to present open issues, ongoing research actions and to present reasonable perspectives.

Presenters' Biographies

Daniel Hissel (M'03 - SM'04) obtained an electrical engineering degree from the Ecole Nationale Supérieure d'Ingénieurs Electriciens de Grenoble, France, in 1994. Then, he obtained a PhD from the Institut National Polytechnique de Toulouse, France, in 1998. From 1999 to 2000, he worked for ALSTOM Transport company where he was system engineer on electrical and fuel cell buses projects. From 2000 to 2006, he has been an Associate Professor at the University of Technology Belfort. From 2006 to 2008, he has been a Full Professor at the University of Franche-Comté and Head of the "Fuel Cell Systems" Research Team of the Laboratory of Electrical Engineering and Systems. In 2008, he joined the FEMTO-ST (CNRS) Institute and became Head of the "Energy systems modelling" research team. Since 2012, he is the Head of the "Hybrid & Fuel Cell Systems, Electrical machines" research team in the same institute. Since 17 years, his main research activities are concerning fuel cell systems dedicated to automotive and stationary applications, modelling, non linear control and energy optimization of these systems and fuel cell system diagnostic/prognostic. He is a former Associate Editor of IEEE Transactions on Industrial Electronics and Associate Editor of ASME Fuel Cell Science and Technology. He is the President of the IEEE VTS French Chapter and member of the advisory board of the MEGEVH network, the French national network on EV and HEV. He is also currently the Director of the FCLAB (Fuel Cell Lab) Research Federation (CNRS), gathering 120 researchers in hydrogen-energy technologies and fuel cell systems. He has published more than 400 scientific papers in peer-reviewed international journal and/or international conferences.

Marie-Cécile Péra obtained an electrical engineering degree from the Ecole Nationale Supérieure d'Ingénieurs Electriciens de Grenoble, France, in 1990. She received a PhD in electrical engineering from the Institut National Polytechnique de Grenoble, in 1993. From 1994 to 1999, she was an Associate Professor at the University of Reims Champagne Ardennes, where she studied non-linear dynamics of electrical systems, based on chaos theory. Since 1999, she has joined the University of Franche Comte (UFC) where she launched the activities on Fuel Cell Systems. In September 2008, she became a full Professor and joined the FEMTO-ST Institute. From 2008 to 2012, she was the deputy Head of the Energy Department of FEMTO-ST. She works on energy management of hybrid electric power generation systems (fuel cells, PEMFC and SOFC, supercapacities, batteries), the diagnosis and prognostics of fuel cell systems. Since 2012, she has been the deputy Director of the FEMTO-ST Institute (800 persons) and a member of the FCLAB Research Federation. She's member of the Scientific Council of the department of Engineering and Systems Sciences of the National Center for Scientific Research (CNRS). She has contributed to more than 250 publications in peer-reviewed international journals and international conferences.

Intended audience

No specific background is required. All information about fuel cell technology and also its application in mobile devices will be provided during the tutorial to the audience.

References

[1] Gouriveau, R., Hissel, D., "PHM of fuel cell systems", Tutorial, IEEE International Conference on PHM, Denver, USA, 2012.

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[3] Li, Z., Outbib, R., Giurgea, S., Hissel, D., "Diagnosis for PEMFC Systems: A Data-Driven Approach With the Capabilities of Online Adaptation and Novel Fault Detectionl", IEEE Transactions on Industrial Electronics, vol. 62, n°8, pp. 5164-5174, 2015.

[4] Boulon, L., Bouscayrol, A., Hissel, D., Pape, O., Péra, M.C., "Inversion-based control of a highly redundant military HEV", IEEE Transactions on Vehicular Technology, vol. 62, n°2, pp. 500-510, 2013.

[5] Solano, J., Hissel, D., Péra, M.C., Amiet, M., "Practical Control Structure and Energy Management of a Heavy Duty Hybrid Electric Vehicle", IEEE Transactions on Vehicular Technology, vol. 60, n°9, pp. 4138-4152, 2011.

[6] Boulon, L., Hissel, D., Bouscayrol, A., Péra, M.C., "From Modeling to Control of a PEM Fuel Cell Using Energetic Macroscopic Representation", IEEE Transactions on Industrial Electronics, vol. 57, n°6, pp. 1882-1891, 2010.

[7] Talj, R., Hissel, D., Ortega, R., Becherif, M., Hilairet, M., "Experimental validation of a PEM fuel cell reduced model, and a moto-compressor higher order sliding mode control", IEEE Transactions on Industrial Electronics, vol. 57, n°6, pp. 1906-1913, 2010.