POWER ELECTRONICS

Component

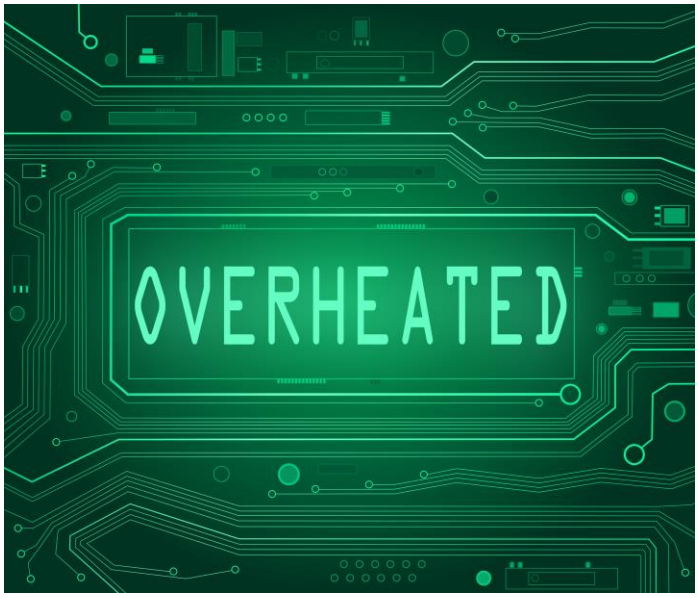
TOULOUSE TECH TRANSFER

Non intrusive component junction temperature measurement method

To perform preventive maintenance and reduce operating costs, the industrial demand for monitoring functions of equipment is increasing. Temperature monitoring can be done with thermal diodes being costly to implement or with thermocouples facing derivations over time, and both solutions are intrusive.

PRESENTATION OF THE SOLUTION*

- Temperature measurement made into the driver board
- Measurement method based on the thermal sensitivity of a component intrinsic characteristic:
  - Current injection and insulation at chip terminals
  - Coupled with an acquisition and treatment system
- Accurate measurement enabling operating specifications optimization
- Real time measurement of any standard power devices



COMPETITIVE ADVANTAGES

- Component junction temperature
- Measurement accuracy
- Non intrusive method
- Long term reliability

APPLICATIONS

- Real-time monitoring (on-line)
- Specific diagnostic (off-line)
- Ageing & damages study of power devices & packaging
- Industries:
  - Oil & drilling
  - Power generation
  - Aeronautics
  - Automotive

INTELLECTUAL PROPERTY

- Patent pending

DEVELOPMENT STAGE

- Experimental proof of concept

1	2	3	4	5	6	7	8	9

LABORATORY

Laplace

- Statics Converters Group

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* Technology requiring license rights.

POWER ELECTRONICS

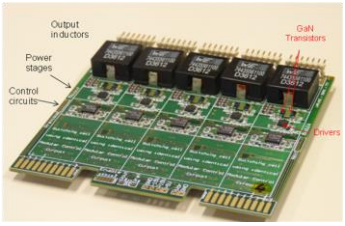
Converter control

Masterless & decentralised control of converter

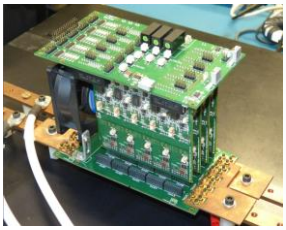
The latest converter architectures use associations of switching cells in series and/or parallel to reduce stress on each switch, while providing flexibility. This increasing number of switching cells leads to control issues and a large quantity of wires.

DESCRIPTION*

- Decentralized modular solution (real masterless) for parallel and/or serial converter control
- Duplication and integration (“copy/paste”) of a unique control module to each switching cell – instead of a centralized control circuit – regardless the number of legs
- Interconnection of control modules in a daisy-chaining configuration providing a balanced and dynamic control system
- Considerable simplification and reduction in wiring of the control of the overall converter
- No service disruption in case of component failure: reconfiguration ability



GaN boards: 5 identical legs managed by the decentralized controller (with eGaN FETS EPC1001, 10.6x10.2cm²)



Multiphase 25-cell GaN interleaved converter (Vin=12-48V Vout=1-12V, 5x75A, Fsw =0.5-3MHz)

TECHNICAL SPECIFICATIONS

	Generic specs	Prototype specs
Type of converter	AC/DC, DC/DC	DC/DC, 5x 1,8kW
Topologies	Multi-cellular	Parallel multi-phase
Nb of switching cells	Unlimited	25
Input voltage	Configurable	12V to 48V
Output voltage	Configurable	1V to 28V
Output current	Configurable	5 x 75A (15A by cell)
Efficiency	-	Max 95%
Switching frequency	Configurable	100kHz to 3MHz

COMPETITIVE ADVANTAGES

- Reliability
- Security
- Ease of implementation
- Flexible system architecture
- Space saving
- Costs reduction

APPLICATIONS

- Micro computing
- Data center
- Automotive
- Aeronautics
- Telecommunications

INTELLECTUAL PROPERTY

- Patent pending

DEVELOPMENT STAGE

- Technology validated at lab level

1	2	3	**4**	5	6	7	8	9

LABORATORY

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POWER ELECTRONICS

Topology

TOULOUSE TECH TRANSFER

Fail-Safe & Fault-Tolerant architecture for converter

Electronic power systems play an increasing role in sensitive applications. These systems must withstand hard stresses, and any failure is a critical event causing application downtime.

PRESENTATION OF THE SOLUTION*

- Security system allowing internal failure confinement and backup cell launching
- A passive coupling and switching circuit shifting to an unique backup cell
- Continuity of service at full power rate after a power device failure
- On line non-intrusive diagnostic of the backup cell

COMPETITIVE ADVANTAGES

- Fail-Safe capability
- Security
- Post-fault continuation
- Redundancies reduction
- Generic concept

APPLICATIONS

- Power generation
- Motor control
- Marine industry
- Rail industry
- Aeronautics
- Automotive

INTELLECTUAL PROPERTY

- Patent in force

DEVELOPMENT STAGE

- Experimental proof of concept

1	2	3	4	5	6	7	8	9

LABORATORY

Laplace

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TECHNICAL SPECIFICATIONS

Converters	AC/AC, DC/AC, DC/DC
Power level	kW to MW

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OPTIQUE

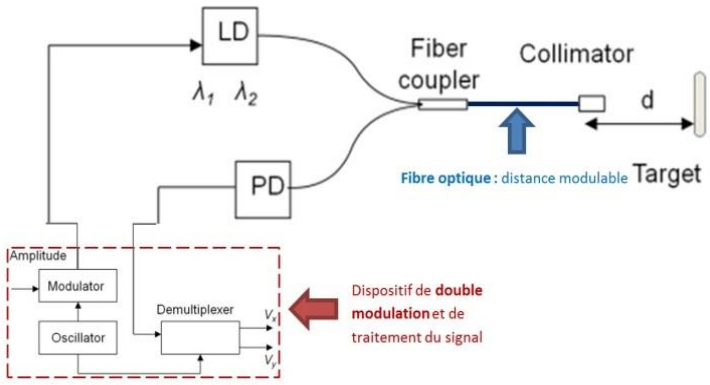
Métrologie laser

Dispositif robuste de mesure déportée de déplacement en environnement contraint

En environnements sévères (radioactif, haute température) ou difficiles d'accès, les dispositifs de métrologie sans contact subissent des perturbations qui peuvent altérer les mesures.

PRÉSENTATION DE LA SOLUTION*

- Technologie basée sur l'interférométrie Fabry-Pérot offrant une grande précision de mesure
- Introduction d'une double modulation permettant de :
  - Connaître le sens du déplacement de la cible
  - Détecter de très faibles déplacements
- Utilisation de fibre optique :
  - Absence d'électronique embarquée
  - Système insensible aux perturbations



SPÉCIFICATIONS TECHNIQUES

Contact avec la cible requis	Non
Bande passante	De 10^{-3} Hz à 5 KHz
Temps de réponse	Temps réel
Déplacement minimum détectable	2 nanomètres
Précision de la mesure	1 nanomètre
Longueur du système	Plusieurs km

AVANTAGES CONCURRENTIELS

- Stabilité et robustesse du système
- Précision de la mesure
- Simplification d'installation
- Mesure déportée

APPLICATIONS

- Mesure de déplacement en environnements :
  - Contraints
  - Difficiles d'accès
- Contrôle qualité

PROPRIÉTÉ INTELLECTUELLE

- Demandes de brevet déposées

ÉTAPES DE DÉVELOPPEMENT

- Prototype en environnement réel

1 2 3 4 5 **6** 7 8 9

LABORATOIRE

- Groupe Optoélectronique pour les Systèmes Embarqués (OSE)

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* Technologie soumise à licence.

OPTICS

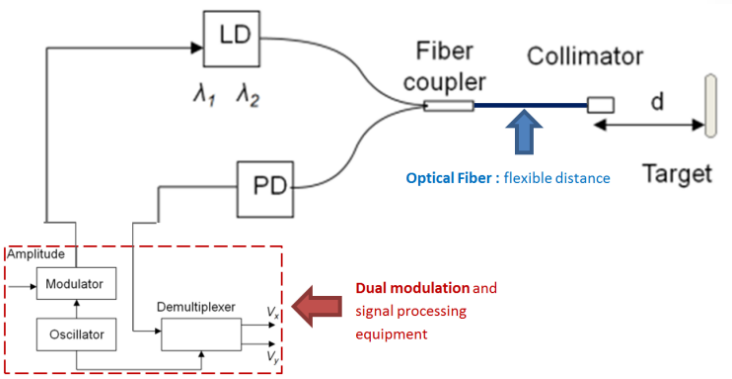
Laser metrology

Remote measurement system for harsh environment

Extreme conditions (high temperatures, radio-activity…) or harsh environments can disturb contactless measurement systems and involve measurement errors.

PRESENTATION OF THE SOLUTION*

- Fiber laser system based on Fabry-Perot interferometry
- The system is based on dual modulation:
  - An optical fiber combined with a collimator forming the detection module
  - An electronic part forming the treatment module
- This system architecture enables to:
  - Identify target movements' direction
  - Detect very slight movements
- Due to the use of optic fiber :
  - Disturbance tolerance of the system
  - No embedded electronics within the measurement zone



TECHNICAL SPECIFICATIONS

Target Contact	No
Bandwidth	10^{-3} Hz to 5 KHz
Response Time	Real Time
Minimum Detectable Move	2 Nanometers
Measurement Accuracy	1 Nanometer
Distance to the target	Kilometers

COMPETITIVE ADVANTAGES

- Measurement accuracy
- Robustness
- Stability of the system
- Easy to implement
- Remote measurement

APPLICATIONS

- Applicable in harsh & hard to access environments
- Monitoring:
  - Structure
  - Seismic
  - Geophysics
- Multi-points measurement

INTELLECTUAL PROPERTY

- Patent pending

DEVELOPMENT STAGE

- Technology demonstrated in relevant environment

1 2 3 4 5 **6** 7 8 9

LABORATORY

- Team XXXXXXX

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OPTICS

Laser metrology

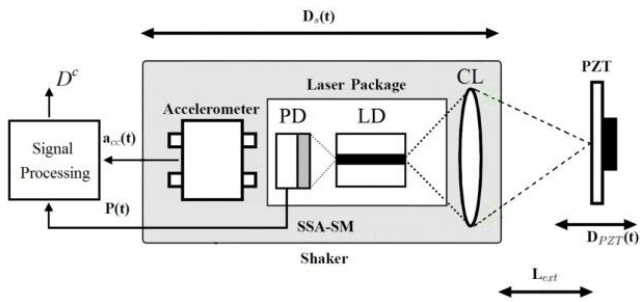
TOULOUSE TECH TRANSFER

Contactless & low-cost embedded system for on-board vibration measurement

Laser based vibration measurement systems requires a vibration proof table, restraining their scope of applications, besides high cost.

PRESENTATION OF THE SOLUTION*

- Based on optical feedback interferometry (“self-mixing” effect), the laser is used as light source, micro-interferometer and detector at once, resulting into a low-cost integrated system
- Coupled with an accelerometer measuring the laser sensor own movements, the device is robust to parasitic vibrations



TECHNICAL SPECIFICATIONS

Target	All
Target preprequisites	None
Bandwidth	20 Hz up to 40 KHz
Measurement range	10 m
Precision	10 up to 100 nanometers
In-depth analysis	No
Target Contact	No
Response Time	Real Time
Robutness	Yes
Prototype size	15 cm x 5 cm (sensor: 9 mm)
Measurement Frequency	Point to point
Cost	Very Low

COMPETITIVE ADVANTAGES

- Compact (embedded system)
- Deployment flexibility
- Robust
- Cost Efficient

APPLICATIONS

- Non destructive testing applications:
  - Operating industrial conditions
  - Embedded applications

INTELLECTUAL PROPERTY

- Patent in force

DEVELOPMENT STAGE

- Experimental proof of concept

1 2 **3** 4 5 6 7 8 9

LABORATORY

LAAS-CNRS

INP TOULOUSE ENSEEIHT

- Optoelectronics integrated & embedded ystems research Group (OSE)

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POWER ELECTRONICS

Architecture

TOULOUSE TECH TRANSFER

A design tool for power electronics systems

More and more demanding specifications require a dedicated tool to design high performance static converters and evaluate efficiency and weight at an early stage of the design.

PRESENTATION OF THE SOLUTION*

- A dedicated pre-design tool to design high performance static converters:
  - Evaluation of efficiency and weight at an early stage of the design
  - Consideration of different degrees of freedom (topologies & technologies)
- Main features:
  - Configurable power converter: multilevel topology & modulation type
  - Fast simulation of steady state wave forms
  - Operating point determination
  - Technology consideration: active & passive components and materials databases
  - Physical parameters sweep
- Enable tradeoff choices for high power converter topologies
- Direct connection to conventional simulation tools for post-check

COMPETITIVE ADVANTAGES

- Ease of use
- Quick response
- Time saving
- Development cost reduction
- Transversal tool
- Modular software

APPLICATIONS

- Power generation
- Aeronautics
- Automotive
- Railway industry

INTELLECTUAL PROPERTY

- Copyright

DEVELOPMENT STAGE

- Technology validated at lab level

1 2 3 **4** 5 6 7 8 9

LABORATORY

Laplace

- Static converters Group

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* Technology requiring license rights.

OPTICS

Laser metrology

TOULOUSE TECH TRANSFER

Fiber-optic based inclinometer for harsh environment

Extreme conditions (high temperatures, radio-activity…) disturb measurements accuracy and precision over time.

PRESENTATION OF THE SOLUTION*

- The inclinometer is made of mechanical & optical elements:
  - Pots containing a volume & height of liquid, allowing the liquid to flow between them (communicating vessels)
  - Fiber-optic sensor for liquid level measurement
- The fiber-optic system is based on dual modulation:
  - Detection module: fiber-optic combined with a collimator
  - Processing module: remote electronic system
- The system architecture enables:
  - Stability control in the long term
  - Disturbance tolerance (no electronics in measurement zone)
  - Identification of target movements' direction
  - Detection of very slight movements

TECHNICAL SPECIFICATIONS

Target Contact	No
Bandwidth	10^{-3} Hz to 5 KHz
Response Time	Real Time
Minimum Detectable Move	2 Nanometers
Measurement Accuracy	1 Nanometer
Angular movements	< 1 Nanoradian
Distance to the target	Kilometers

COMPETITIVE ADVANTAGES

- Measurement accuracy
- Robustness
- Stability of the system
- Easy to implement
- Remote measurement
- Multi-points measurement

APPLICATIONS

- Harsh & hard-to-reach areas
- Drilling and galleries
- Monitoring:
  - Civil engineering/Structure
  - Seismic
  - Geophysics

INTELLECTUAL PROPERTY

- Patent pending

DEVELOPMENT STAGE

- Technology demonstrated in relevant environment

1	2	3	4	5	**6**	7	8	9

LABORATORY

LAAS-CNRS

INP TOULOUSE ENSEEIHT

- Team: Optoelectronics for Embedded Systems

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AÉRODYNAMIQUE

Aéroélasticité et dynamique des structures

Conception de profil aérodynamique d'atténuation des instabilités tourbillonnaires

Les approches actuelles en aérodynamique font appel à de fortes puissances électriques. La conception de matériaux par morphing capables d'être capteurs et actionneurs, en emmagasinant et utilisant l'énergie vibratoire environnante offre des solutions alternatives ou complémentaires.

PRESENTATION DE LA SOLUTION*

- Conception de profil pour la réduction de trainée aérodynamique et augmentation de portance grâce à un contrôle électro-actif des écoulements
- Morphing par hybridation de matériaux électroactifs pour obtenir simultanément et de manière ciblée des changements de forme en interaction avec les sollicitations extérieures et par manipulation de la turbulence :
  - Génération de petites amplitudes de déplacements pour la haute fréquence (200 à 1 000 Hz) grâce à des matériaux piézoélectriques (type PZT ou polymères PVDF)
  - Génération de grandes déformations pour les basses fréquences (1 à 20 Hz) grâce à des alliages à mémoire de forme (nickel-titane)
- Association de matériaux flexibles et intelligents capable de changer de forme et de se mouvoir en interaction avec les sollicitations extérieures en bio-inspiration

AVANTAGES CONCURRENTIELS

- Augmentation de la portance
- Diminution de la résistance au vent
- Réduction du bruit
- Contrôle de la turbulence
- Manœuvrabilité
- Faible coût énergétique

APPLICATIONS

- Structures
- Voilures
- Pâles
- Ailes
- Ailerons
- Ailettes
- Winglet
- Déflecteurs

PROPRIÉTÉ INTELLECTUELLE

- Brevet
- Savoir-faire

ÉTAPES DE DÉVELOPPEMENT

- Preuve expérimentale du concept

1 2 **3** 4 5 6 7 8 9

LABORATOIRE

IMFT INSTITUT DE MECANIQUE DES FLUIDES DE TOULOUSE

- EMT2 (Ecoulements Monophasiques Transitionnels et Turbulents)

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* Technologie soumise à licence.

Septembre 2015.

AERODYNAMICS

Aeroelasticty & structural dynamics

TOULOUSE TECH TRANSFER

Electroactive morphing for aerodynamic performance improvement of air systems

The need to improve the aerodynamic performance of air system is subject to intense research on real-time optimization of airfoil shape. This optimization can be achieved by morphing the airfoil using adequate materials and actuators.

PRESENTATION OF THE SOLUTION*

- Design for reduced aerodynamic drag and increasing lift with electro-active control of flows using smart-material actuators
- Morphing by hybridization of electroactive materials for simultaneously and purposefully shape changes, in interaction with external forces and by manipulating the instabilities
- Two distinct actuation types:
  - Low displacements for high frequencies (200 -1 000 Hz) using piezoelectric (PZT or PVDF polymers) for improving the aeroelastic coupling effect inducing both noise and drag
  - Large displacements for low frequencies (1-20 Hz) with shape memory alloys (nickel titanium) targets primarily the flight control
- Association of flexible and smart materials that can change shape and move in interaction with external stresses in bio-inspiration

COMPETITIVES ADVANTAGES

- Real time
- Increase in lift
- Decreasing wind resistance
- Noise reduction
- Control of instabilities
- Maneuverability
- Low energy cost

APPLICATIONS

- Structures
- Pales
- Wings
- Fins
- Winglet
- Deflectors

INTELLECTUAL PROPERTY

- Patent
- Know-how

DEVELOPMENT STAGE

- Experimental proof of concept

1	2	3	4	5	6	7	8	9

LABORATORY

IMFT INSTITUT DE MECANIQUE DES FLUIDES DE TOULOUSE

- EMT2 (Single-phase transitional and turbulent flows)

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MÉCATRONIQUE

Contrôle commande

Dispositif de commande passif magnétique

Les dispositifs de commande passif à retour d'effort utilisent classiquement des ressorts et amortisseurs. Ces composants présentent un risque de dérive de la précision due à l'usure des pièces mécaniques (frottements) et aux jeux mécaniques. De plus, le dimensionnement de ces pièces mécaniques est complexe.

DESCRIPTION*

- Dispositif de commande passif magnétique, mettant en œuvre un manche de pilotage équipé d'un système magnétique :
  - Effort proportionnel à la déviation (effort/débattement)
  - Retour amorti au point milieu
  - Verrouillage au point neutre
- Dispositif basé sur le principe d'attraction et répulsion magnétique d'aimants permanents
- Le dispositif peut être mis en œuvre seul, ou en complément d'un système actif à base d'actionneurs électromagnétiques, en cas de perte du système actif
- Les caractéristiques mécaniques du dispositif :
  - Nombre réduit de pièces (suppression pièces métalliques)
  - Limitation des pièces en mouvement
  - Meilleure résistance à l'usure des aimants

SPÉCIFICATIONS TECHNIQUES

Température de désaimantation	Entre 100°C et 150°C
Effort type (robustesse)	80 kg
Effort/débattement	Pour un angle de +/- 15°: effort de +/- 2daN
Break-out (point milieu)	Pour un angle de 0° (point milieu) : effort de +/- 0,2daN

AVANTAGES CONCURRENTIELS

- Réduction de poids
- Réduction d'encombrement
- Réduction de coût
- Réduction des frottements mécaniques et de l'usure
- Facilité d'implémentation
- Compatibilité système actif

APPLICATIONS

- Pilotage de machines :
  - Aéronef (avions, hélicoptères, drones)
  - Véhicules marins ou terrestres
  - Engins de manutention
  - Machines agricoles
- Vidéo & simulateur
- Télé-opérations :
  - Robotique
  - Médicale
  - Instrumentation

PROPRIÉTÉ INTELLECTUELLE

- Demande de brevet déposée

ÉTAPES DE DÉVELOPPEMENT

- Preuve expérimentale du concept

1 | 2 | **3** | 4 | 5 | 6 | 7 | 8 | 9

LABORATOIRE

Laplace

- Groupe de Recherches en Electrodynamique, Matériaux, Machines et Mécanismes Electroactifs (GREM3)

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* Technologie soumise à licence.

MECATRONICS

Control system

Magnetic passive control

The passive control devices force feedback typically use springs and dampers. These components present a risk of drift of the accuracy due to wear of mechanical parts (frictions). In addition, the dimensioning of these mechanical components is complex.

DESCRIPTION*

- A magnetic passive control, implementing a control stick equipped with a magnetic system:
  - Proportional to the deviation force (force / deflection)
  - Force feedback amortized at the middle point
  - Locking at the neutral point
- A device based on the principle of attraction and magnetic repulsion of permanent magnets
- The device can be implemented alone, or in addition to an active system based on electromagnetic actuators, in case of loss of the active system
- The mechanical characteristics of the device:
  - Reduced number of parts (metallic parts removal)
  - Limitation of moving parts
  - Better wear resistance of magnets

TECHNICAL SPECIFICATIONS

Demagnetization temperature	b/w 100°C and 150°C
Effort type (robustness)	80 kg
Effort-deflection	For an angle of +/- 15°: effort of +/- 2 daN
Break-out (middle point)	For an angle of 0° (middle point): effort of +/- 0,2 daN

COMPETITIVE ADVANTAGES

- Weight reduction
- Reduced overload
- Cost reduction
- Reduced mechanical frictions and wear
- Ease of implementation
- Active system compatibility

APPLICATIONS

- Steering machines:
  - Aircraft (airplanes, helicopters, drones)
  - Marine or land vehicles
  - Cargo Gear
  - Agricultural & construction machinery
- Video & simulator
- Remote operations:
  - Robotics
  - Medical
  - Instrumentation

INTELLECTUAL PROPERTY

- Patent pending

DEVELOPMENT STAGE

- Experimental proof of concept

1 2 **3** 4 5 6 7 8 9

LABORATORY

Laplace

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* Technology requiring license rights.

POWER ELECTRONICS

Converter control

TOULOUSE TECH TRANSFER

Decentralized control of converter for high voltage and high power applications

The market for voltage-source converter HVDC is growing fast. The Modular Multi-Level Converter (MMC) emerging as a front-runner, jointly with the Static Synchronous Compensator (STATCOM). Both have disadvantages: a complex control due to floating capacitors, and they are large and bulky.

PRESENTATION OF THE SOLUTION*

- Decentralized modular solution for serial converter control
- Duplication and integration ("copy/paste") of a unique control module to each switching cell regardless the number of legs
- Reduction of the efforts (less data to be exchanged) on the supervisor by distributing them among several switching cells
- Interconnection of control modules in a daisy-chaining configuration providing a balanced and dynamic control system
- Considerable simplification and reduction in wiring of the control of the overall converter
- No service disruption in case of component failure

TECHNICAL SPECIFICATIONS

Type of converters	Modular Multilevel Voltage Source Converters (STATCOM, MMC)
Voltage range	10 kV to 1000 kV
Power level	Few MW to GW
Nb of switching cells	Unlimited

COMPETITIVE ADVANTAGES

- Reliability
- Security
- Ease of implementation
- Flexible system architecture
- Space saving
- Costs reduction

APPLICATIONS

- Electrical power transmission networks (HVAC or HVDC)
- SmartGrids (MVAC or MVDC)
- Frequency converter for Railway Networks
- Wind power system
- Metallurgy

INTELLECTUAL PROPERTY

- Patent pending

DEVELOPMENT STAGE

- Experimental proof of concept

1 2 **3** 4 5 6 7 8 9

LABORATORY

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POWER ELECTRONICS

Converter Topology

TOULOUSE TECH TRANSFER

DC/DC partial power converter for multisource systems

Controlling the power flow between multiple sources generally uses static converters with a total installed power equal to the power to be handled. The partial power architecture can achieve the same goal using a converter designed for typically 20-30% of the total power, which means typically a cost reduction of 50% and a loss reduction around 60%.

DESCRIPTION*

- This architecture of DC/DC converters allows controlling the power flowing between one group of sources (typically photovoltaics modules, supercapacitors, batteries, Light Emitting Diodes,…) and another source (typically a DC bus)
- It can be oriented to reach different goals:
  - Control the voltage applied to each source of the group to optimize the operation, for example, Maximum Power Point Tracking of multistring PV systems
  - Control the power transferred to each element of a group of loads (e.g. the LEDs composing a high power lighting system) or taken from each element of a group of sources (e.g. the different elements of a group of batteries)

TECHNICAL SPECIFICATIONS

Input voltage	300V to 1.8kVdc
Power	1KW to 10MW
Efficiency	>98%

COMPETITIVE ADVANTAGES

- Simple and modular structure
- Versatile architecture
- Power Flow control
- Higher efficiency
- Lower cost

APPLICATIONS

- Photovoltaics
- Rail/Tramway
- Automotive
- High power Lighting (with LED)

INTELLECTUAL PROPERTY

- Patent pending

DEVELOPMENT STAGE

- Technology concept formulated

1 | **2** | 3 | 4 | 5 | 6 | 7 | 8 | 9

LABORATORY

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RÉSEAUX ÉLECTRIQUES

Gestion des perturbations par filtrage actif commandé

Optimisation de l'énergie électrique dans un système multi-sources

La pollution des réseaux électriques par des courants harmoniques est une conséquence inévitable de l'augmentation des charges non linéaires engendrant des courants harmoniques et des distorsions dans les différents réseaux électriques.
L'ajout d'une loi de commande adaptée à des filtres actifs parallèles permet la réduction importante des harmoniques et le rééquilibrage du réseau.

DESCRIPTION*

- La solution repose sur une loi de commande implantable sur des filtres actifs parallèles
- Elle permet d'obtenir un système triphasé, équilibré et sinusoïdal de courant pour la source de tension déséquilibrée et perturbée en harmoniques
- Le principe de la stratégie est basé sur la répartition des puissances actives absorbées par la charge et le filtre sur les phases de la source
- Le système est alors équilibré en courant avec un facteur de puissance unitaire même lorsque les tensions sont déséquilibrées et perturbées

SPÉCIFICATIONS TECHNIQUES

Gestion tension perturbée	Facteur de puissance unitaire (FPU) et courant de neutre quasi-nul
Nombre d'opérations limité	Jusqu'à -40% par rapport aux méthodes classiques (PQR…)
Facilité d'implémentation	Boucle de verrouillage de phase non requise

TOULOUSE TECH TRANSFER

AVANTAGES CONCURRENTIELS

- Loi de commande universelle applicable :
  - Aux filtres adaptables aux réseaux haute et basse tensions (gestion du neutre)
  - Aux signaux mono et tri-phasés
- Coût d'implémentation limité
- Solution robuste et fiable

APPLICATIONS

- Réseaux intelligents « Smart Grids »
- Sites isolés alimentés par des sources d'énergie locale (photovoltaïque, pile à combustible...)
- Réseaux embarqués
- Réseaux susceptibles d'être perturbés en tension

PROPRIÉTÉ INTELLECTUELLE

- Demande de brevet déposée

ÉTAPES DE DÉVELOPPEMENT

- Preuve expérimentale de conception

1	2	3	4	5	6	7	8	9

LABORATOIRE

Laplace

- Equipe de recherche : CODIASE

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