Supercapacitor Assisted Dual-mode Surge Protector

Conference Paper · November 2018

1 author:

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15 PUBLICATIONS **9** CITATIONS

Some of the authors of this publication are also working on these related projects:

Lecture Notes in Physics View project

PhD Research Work View project

Waikato Young Research Engineers Symposium (WYRES)

THE UNIVERSITY OF WAIKATO | ENGINEERING

The conference topics include but are not limited to:
- **Chemical and Biological Engineering**
- **Civil and Environmental Engineering**
- **Electronic Engineering**
- **Materials and Process Engineering**
- **Mechanical Engineering**

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

WYRES 2018 Conference programme

Date: Thursday the 1st November 2018

Venue: Gallagher Academy, Gate 1, Knighton Road, The University of Waikato, Hamilton, Waikato, New Zealand

WYRES aims to promote critical research thinking, encourage exchange of ideas and expertise among researchers with different theoretical, technical and experimental background, and stimulate constructive scientific debating

WHERE THE WORLD IS GOING – TE AHUNGA O TE AO

Time	Dance Studio (Gallagher Academy)	Te Whare Tāpere Iti (Gallagher Academy)
8:45-9:00	WYRES Overture - Leandro (Dance studio)	
9:00-9:30	**Alessandro Fascetti: Materials Across the Scales: Multiscale Methods for Resilient Structures**	**Ali Shokri: An improvement on SCS-CN method for predicting runoff from a storm event**
9:30-9:45	Using Monte Carlo techniques to analyse the effect of stream variability on heat exchanger network retrofits (Nathan Lal)	Jitter calculation in time-of-flight full field range cameras using signal processing techniques (Gehan Anthonys)
9:45-10:00	Tendon displacement and excursion: a design approach to the optimisation of tendon driven artificial and electro-mechanical hands (Mahonri Owen)	Designing, measuring and modelling a small-scale coil and stimulation circuit for transcranial magnetic stimulation (Farah Khokhar)
10:00-10:15	Routes for improving the fatigue performance of powder metallurgy titanium alloys with full density (Carlos Romero)	Screw-press extraction and solvent recovery of leaf proteins from paunch grass and leafy green wastes (Timothy Ng)
10:15-10:30	Selecting suitable wave energy converters for the New Zealand wave climate (Danielle Bertram)	Detrended fluctuation analysis and spectral analysis of anaesthetic-induced phase transition (Malithi Chandrasiri)
10:30-11:00	Tea Break	
11:00-11:30	**Rachael Tighe: Applications of thermography**	**Ginghis Maranan:**
11:30-11:45	CFD modelling of heat transfer in a single block of cheese chilling (Duy Hoang)	Biosensing-by-learning direct targeting strategy for enhanced tumor sensitization (Muhammad Ali)
11:45-12:00	The effect of Mn on the mechanical properties and microstructures of Ti-based alloys (Yousef Alshammari)	Automated yield estimation for kiwifruit orchards (Matthew Seabright)
12:00-12:15	Effluent steroidal hormone treatment by combined adsorption, biological degradation through anaerobic digestion and biochar (Asaf Rachmani)	Model predictive control for externally manipulable, intelligent targeted drug delivery in cancer treatment (Neda Sharifi)
12:15-12:30	Research on interface formation in high-quality copper/diamond composites synthesized by hot forging method (Shanquan Jia)	Use of multiple transformer windings for efficiency enhancement in the series transistor-array based linear AC voltage regulator (Nimesha Wijesooriya)

Time		
12:30-1:30	Lunch	
1:30-2:00	**Ye-Chow Kuang: A personal journey of applying probability theory in industrial automation, artificial intelligence and engineering design**	**Megan Boston: Improving Post Earthquake Hospital Functionality**
2:00-2:15	48 V DC power supply with DC-ups for google 48 V rack power architecture (Thilanga Ariyarathna)	Modelling the spiking behaviour of neurons in human cortex (Sanduni Malluwawadu)
2:15-2:30	Modelling of a RL circuit subjected to a high voltage transient and investigating the importance of inductors in surge protection (Sadeeshvara Silva Thotabaddadurage)	A study of the influence of ambient temperature and humidity on fabricated parts by Fused Deposition Modelling (FDM) (Adel Abdulahmed Ameer)
2:30-2:45	Supercapacitor Assisted Dual-mode Surge Protector (Sadeeshvara Silva Thotabaddadurage)	Evaluation of a time-of-flight range imaging system and review of motion correction approaches (Carl Lickfold)
2:45-3:00	Development of an Automated Lily Bulb Planter (Gerhard Venter)	3D Bioprinting - 'where engineering meets biology' (Shalini Guleria)
3:00-3:30	Tea Break	
3:30-3:45	**Seokho Jeong: Improved prediction of earthquake intensity accounting for the local and regional variability**	Nanocellulose as binder to produce robust oriented short hemp fibre mats (Tom sunny)
3:45-4:00		Effects of competing anions on arsenic removal from contaminated lake water (Aremu James Oyediji)
4:00-4:15	Foaming Protein Plastics - theory and practice (Chanelle Gavin)	Point-cloud filtering using convolutional neural networks for efficient detection of asparagus spears (Matthew Peebles)
4:15-4:30	Wear performance of selective laser melted Ti-6Al-4V alloy in-situ modified with oxygen and boron (Ben Jackson)	Iterative heat and mass integration of hydrothermal liquefaction for bio-crude production (Benjamin Ong)
4:30-4:45	Adaptive foundation for earthquake isolation (Fatemeh Elena Eskandarymalayery)	Supercapacitor Energy based 12 V LED lighting converter for DC-micro grids (Dilini Jayananda)
4:45-5:00		Investigation of heat transfer enhancement using hi-TRAN inserts in double pipe heat exchangers (Kaggwa Abdul)
5:00-5:15	Awards - Leandro (Dance studio)	
5:15-5:30	Closure - Mark Dyer (Dance studio)	

Modelling of a RL circuit subjected to a high voltage transient and investigating the importance of inductors in surge protection

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Abstract. A surge protector device (SPD) basically functions as a filter to remove transients from being transferred to the load device, and each component inside the protector has a specific role towards the goal achievement. A key component found in many SPDs is inductors. In the patented and commercialized SCASA technique developed by the University of Waikato, a coupled-inductor approach is implemented.

This paper mainly focuses on developing a mathematical model for the energy stored in an inductor and the energy dissipated in a resistor during a transient event. The alteration of the ratio between two respective energies is also studied for several resistances and inductances. Considering the practical requirements, the ideal range for the inductance is decided with minimized impedance effects on the domestic AC mains. Under such low impedance conditions, the importance of inductors in surge protection is verified, and using the developed model it can be proven how approximately 50-60% of the surge energy is absorbed by them. This fundamental characteristic of inductors is widely applied in surge protectors.

Supercapacitor Assisted Dual-mode
Surge Protector

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Abstract. Power electronics research group at the University of Waikato is involved with the development of non-traditional applications of supercapacitors, and among them, the patented technique SCASA is a surge protector device (SPD) that is designed to absorb the differential mode (DM) transient surges. But, considering the severity of lightning related surges, the necessity for a more versatile SPD incorporating both differential mode (DM) and common mode (CM) protection is identified.

This paper summarizes the proposed methodology for a versatile dual-mode surge protector including the step by step design of circuit topologies and standard testing procedures. The operation of surge simulators, and the generation of repeated surge hits are discussed under the experimental phase. Laplace transforms and numerical integration methods are used in the theoretical analysis of circuit operations. The novel aspect of this research is the inclusion of supercapacitors; hence, their ability to absorb high voltage transients and surges is distinguished as an important fundamental characteristic when compared with electrolytic capacitors.