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Technical Report LabAccess User Project

A fuzzy logic based efficient and robust control of EVs with open-end winding induction motor drive (FLEVOEWIM [03.126-2021])

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User Group Leader: [Dr. Srinivasan Pradabane(National Institute of Technology, Warangal)

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List of Abbreviations

CO	Project Coordinator
EC	European Commission
LA	Lab Access
UG	User Group
UP	User Project
EV	Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
HEV	Hybrid Electric Vehicle
AEV	All-Electric Vehicles
OEWIM	Open-end Winding Induction Motor
BLDC	Brushless DC motor
SRM	Switched Reluctance Motors
IM	Induction Motors
PMSM	Permanent Magnet Synchronous Motors
MLI	Multilevel Inverter
FOC	Field Oriented Control

Executive Summary

Efficiency is an essential aspect for any electrical vehicle. Among the various traction motor configurations, induction motors are preferred for EVs due to its ruggedness in construction, low initial cost, maintenance-free operation, self-starting, operated at harsh conditions, durability, and low operating cost. However, IMs have poor starting torque and high-inrush currents, but multilevel inverter fed drive configurations gave a kick start to control IMs effectively. The present-day drive configurations may require high-rated power supplies, bulky DC-link capacitors, high power switches in rectifiers/inverters, less switching redundancies and higher power loss in the switching devices, which accounts for poor efficiency and uneven control.

There is a need to develop an efficient drive system for EVs with fast, smooth, robust, and reliable control; hence an Open-End Winding Induction Motor (OWEIM) drive configuration is proposed in this project. In this connection, this project proposes to achieve the following objectives such as developing a FOC based controller for two OEWIM drive system using three three-phase inverters in contrast to the conventional drives using four inverters.

The proposed configuration can be used for a 4-wheel driven EV. Since the number of inverters is only three compared to the conventional four inverters, the cost is reduced. Further, the main advantage of OEWIM drive is that the size of DC link capacitors and ratings of the switches are reduced to half, which in turn reduces the overall cost of the entire drive system. The proposed configuration has several other advantages which include reducing in carbon foot print, reduction in noise and reduction in the bulkiness of the entire drive system.

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1 Lab-Access User Project Information

1.1 Overview

User Project Acronym	FLEVOWEIM
User Project Title	A fuzzy logic based efficient and robust control of EVs with open-end winding induction motor drive
Main Scientific/Technical Field	Energy, Environment
Name of the ACCESS PROVIDER	SINTEF Energi AS
Host Infrastructure	National Smart Grid Laboratory (NSGL)
Address	O.S. Bragstadsplass 2a, Gløshaugen, Trondheim, Norway.
Access period	19-09-2022 to 16-10-2022
Number of ACCESS days	20 days
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Organization activity type	UNI - University and other higher education organizations
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Organization website	www.nitw.ac.in
Organization activity type	UNI - University and other higher education organizations

1.2 Research Motivation, Objectives, and Scope

Efficiency is an essential aspect for any electrically driven vehicle, i.e., Plug-in Hybrid Electric

Vehicles (PHEVs), Hybrid Electric Vehicle (HEV), and All-Electric Vehicles (AEVs). The traction motors used in EVs are Brushless DC (BLDC) motors, Switched Reluctance Motors (SRM), Induction Motors (IM), and Permanent Magnet Synchronous Motors (PMSM). Among the above motor configurations, IMs are preferred for EVs due to its ruggedness in construction, low initial cost, maintenance-free operation, self-starting, operated at harsh conditions, durability, and low operating cost. However, IMs have poor starting torque and high-inrush currents. Several topologies to improvise and control the above two shortcomings were reported in the literature. Thus multilevel inverter (MLI) drive configurations gave a kick start to control IMs effectively, but the present-day drive configurations may require high-rated power supplies, bulky DC-link capacitors, high power switches in rectifiers/inverters, less switching redundancies and higher power loss in the switching devices, which accounts for poor efficiency and uneven control. There is a need to develop an efficient drive system for EVs with fast, smooth, robust, and reliable control; hence an Open-End Winding Induction Motor (OWEIM) drive configuration is proposed. In this connection, this project proposes to achieve the following objectives.

a) To develop a Field Oriented Control (FOC) for an OEWIM drive system for EV.
b) To analyze the proposed FOC with and without fuzzy logic controller.
c) To test the dynamic loading conditions of proposed drive configuration.
d) To evaluate the performance indices of multilevel inverter system viz. voltage and current profiles, THD signature, and cost.

2 State-of-the-Art/State-of-Technology

One of the most popular and environment-friendly alternatives to the IC engine is the development of EVs, which is rising day-by-day steadily. The two basic modes of an EV are charging mode and driving mode. EVs consist of a battery pack, inverter and traction motor for its drive-train configuration. The inverter drives the motor and power requirement is met from the battery pack. Energy can be stored in the battery pack either from the onboard charger or from the fast charging stations. Several advancements have been reported in the literature by researchers all around the world which contributes to the growth of EVs internationally and nationally.

In EVs, either a IM or PMSM is invariably used for driving the wheels [1]–[3]. IMs have superior advantages compared to PMSM that makes it more preferable for the EV applications. The demagnetization of the permanent magnets due to temperature effect and the need for a strong magnet makes it expensive; further, the rotor position sensing sensor is required for PMSM which makes more complicated compared to an IM [4].

Heping Liu, et. al. [5] suggested that the motors employed for drive applications should have exceptional controlled-torque characteristic to satisfy frequent start/stop, speed-up/slowdown, and regeneration energy feedback, increased torque at lower speed, reduced torque and constant power run at higher speed.M. Zeroulia, et.al. [6] compared and analyzed the electric-propulsion systems for a parallel HEV and presented the most suitable choice for the same, which has been accepted widely. The comparative study was drive-specific for electric-propulsion system, which included dc motor, IM, PMSM, and switched reluctance motor (SRM). The analysis suggested that squirrel-cage induction motor meets the major requirements for propelling an HEV. Further study conducted by L. Di Leonardio, et.al [7] conducted studies on type of motor for EVs show that IM is highly recommended for traction applications, which include all configurations of EVs.

Pennycott et.al [8] presented the reduction in energy savings by minimizing the power loss in the motor by with respect to wheel-torque. The loss in power during straight-line drive and inclined slope on EVs for various motors were investigated using off-simulation characteristics. Chih-Ming, et.al. [9] suggested two usage of two power sources for motors as the driving range of the battery electric vehicles (BEVs) had -pronounced driving range. Hence the second source can be a fuel cell or a super capacitor. The presence of two independent sources allows the use of dual inverter to feed the induction motor from both ends. Hence the stator windings are opened and each winding is fed from both ends thereby inviting the advantages of open-end winding induction motor drives (OEWIM) [10].

In the present context, the addition of EVs may depend on transportation policy, energy resource benefits, technological abilities, and legislative prioritization of responses to climate change. In the present scenario, there is a huge demand for the selection of type of motor for EVs. This project envisages a novel topology with open-end winding induction motor drive for EVs. The proposed drive configuration requires less-rated power supplies, low power capacitors and switches in rectifiers/inverters with high switching redundancies. Further an efficient drive system for EVs with fast, smooth, robust, and reliable control can be obtained.

3 Executed Tests and Experiments

3.1 Test Plan and Procedures involved

3.1.1 Test Plan:

a) Introducing open-end winding induction motor (OEWIM) drive (shown in Fig.1) to electric vehicle application. OEWIM is formed by removing the star-point of a conventional induction motor; now the six input terminals are fed by two two-level inverters. With this proposed drive, the possibility of reduction in DC-link capacitors, device power ratings, rectifiers and isolation transformers are to be observed and analyzed.

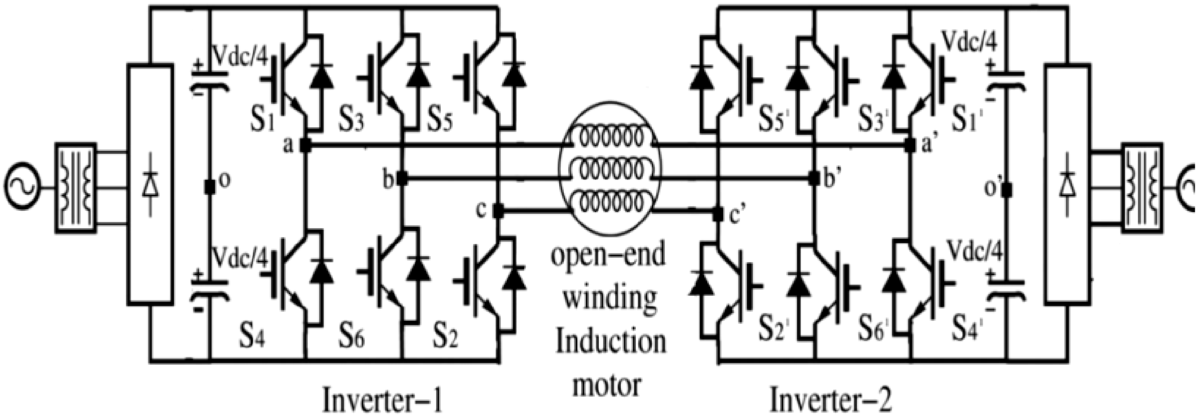

Figure 1: Two Inverters feeding an OEWIM drive

b) A novel three-inverter based two OEWIM drive configuration is proposed for four wheel drive in EV. In EVs there are several conditions which demand four-wheel driven operation. An OEWIM drive topology for four-wheel driven EVs requires four inverters for powering them; two inverters for each OWEIM. This makes the entire setup bulky and costly. Hence a novel OEWIM drive topology, which requires only three inverters for feeding two OEWIM drive system is proposed as shown in Fig. 2. It is also necessary to evaluate the proposed method and reduce the required power sources.

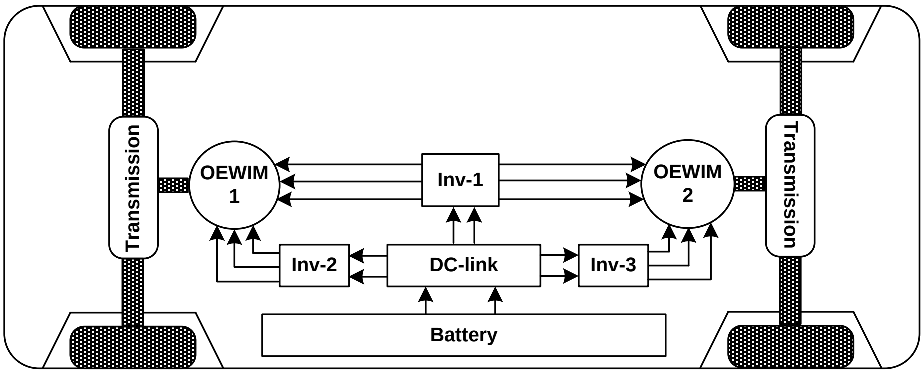

Figure 2: Four-wheel driven EVs using triple inverters feeding two OEWIMs

e) A Field Oriented Control (as in Fig. 4) approach needs to be developed. The proposed methodology uses a mathematical model to evaluate the current from the rotating reference frame of the d, q axes for the OEWIM as the proposed drive requires a robust and efficient control technique for smooth operation of the EV.

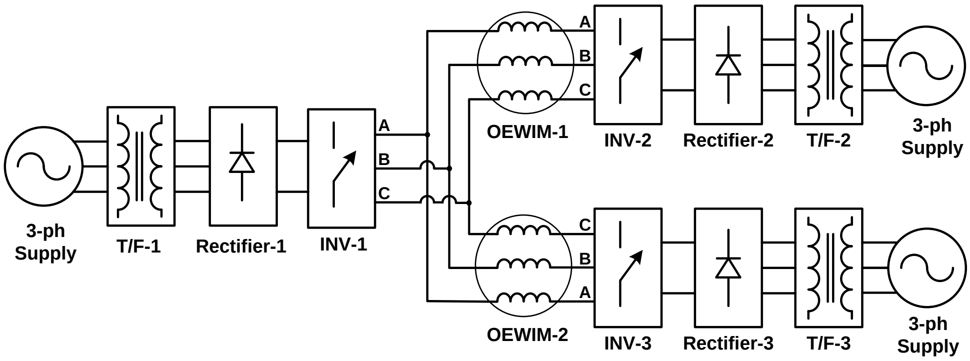

Figure 3: Block diagram of a three isolated inverters feeding two OEWIMs

f) Further the proposed FOC method using fuzzy logic needs to be analyzed and a comparative study will be carried out over the conventional method.

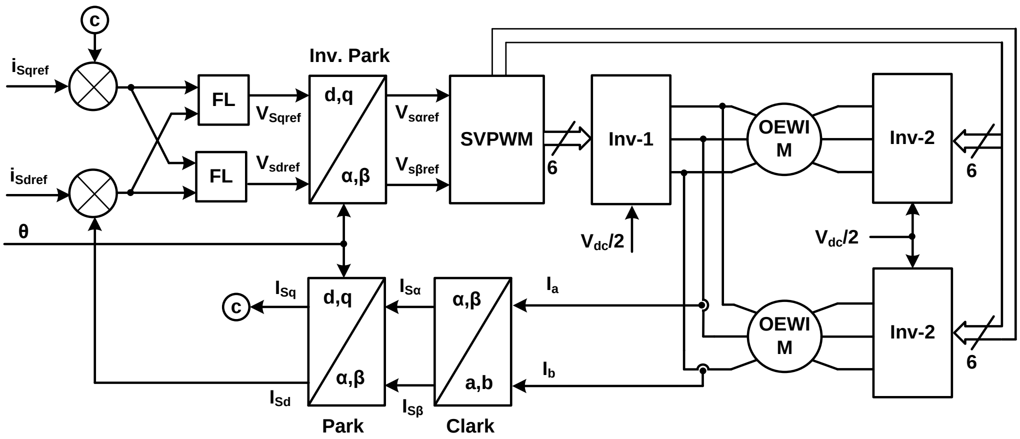

Figure 4: Four-wheel driven EVs using triple inverters feeding two OEWIMs

g) To establish the experimental setup and test the proposed system under dynamic loading conditions. During the process the performance indices such as voltage, current, THD signature, torque and speed are to be evaluated.

3.1.2 Procedures involved:

a) The proposed work was simulated in MATLAB/Simulink environment.

b) The proposed topology was implemented in using three three-phase IGBT inverters.

c) The controlling aspect was designed and gating signals were generated using OPAL RT 4510 platform.

d) Two open-end winding induction motors were used to test the operation of this topology.

The motors showed good response up to 25% of rated speed, however the set up suffered from tripping of the inverter protection circuits above 25% of the rated speed.

e) The voltage, current and speed were observed during clockwise and anticlockwise direction of the rotation of the motor.

3.1.3 Types of testing:

Two types of testing were undertaken during the execution of the project. First being the SIL and upon successful operation, the HIL testing was performed.

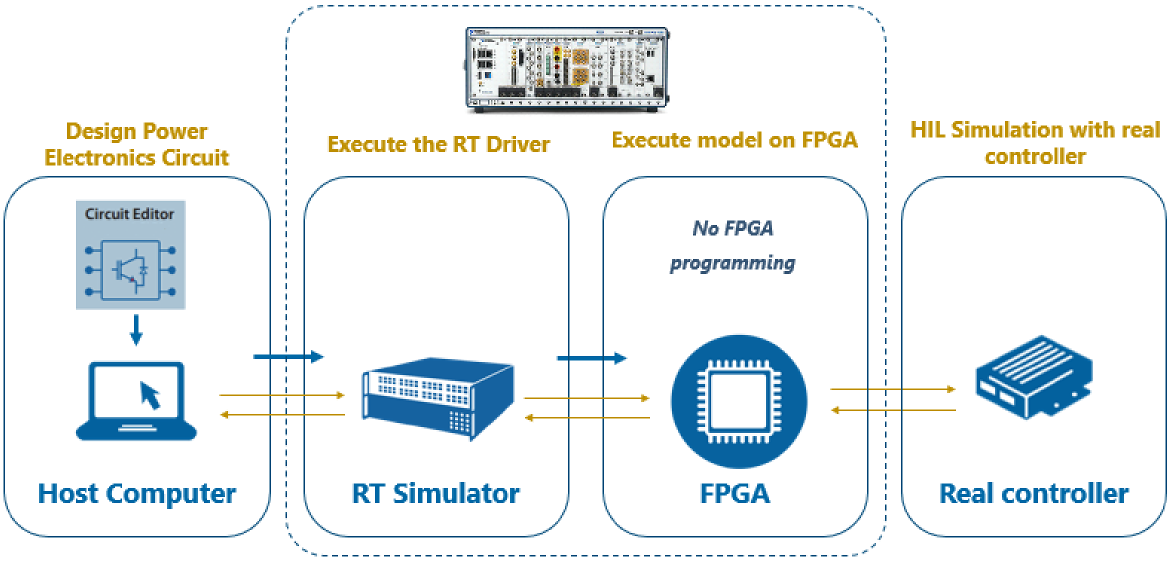

Figure 5: Experimental setup of three three-level inverter fed two OEWIM drive

3.2 Test Set-up(s)

The test setup involved building of the two level inverter, interfacing the inverter control circuit to the FPGA processor OPAL RT 4510; and connecting the inverters to the two open-end winding induction motor drives. The pictorial images indicate the test setups for the proposed project. Figure 6 shows the complete setup, which included the three phase inverter-1, inverter-2 and inverter-3 in a stack. The Programmable 15 kW DC power supply was used to feed the DC link of the three inverters. A Hall Effect current sensor is fitted to the converter output which is used to sense the current in the motor phases.

Two open-end winding induction motors are used in the setup as indicated in Figure 7. A DC generator is connected to each shaft of the two OEWIMs. The DC generators are in turn connected to the resistive load bank. Figure 8 shows the Inverter-1 with driver cards in place. The same is replicated for the other two inverters which is not shown in the same figure for the sake of redundancy.

Figure 6: Experimental setup of three three-level inverter fed two OEWIM drive

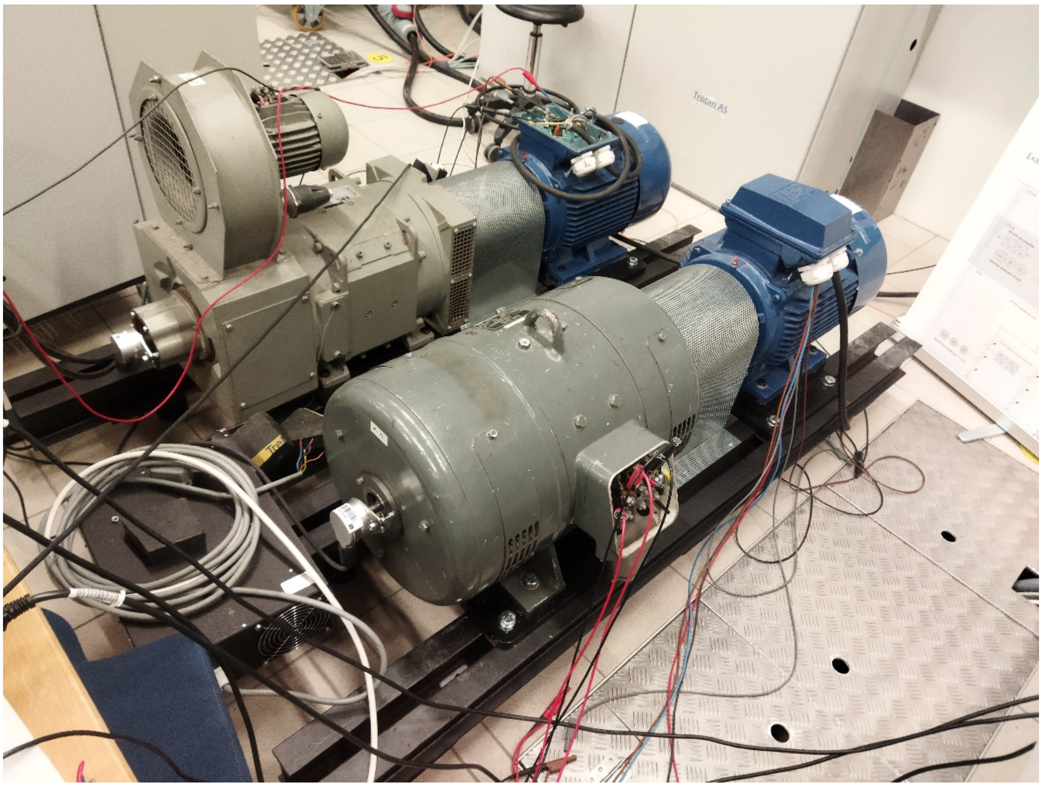

Figure 7: Two Open-end winding induction motor drives

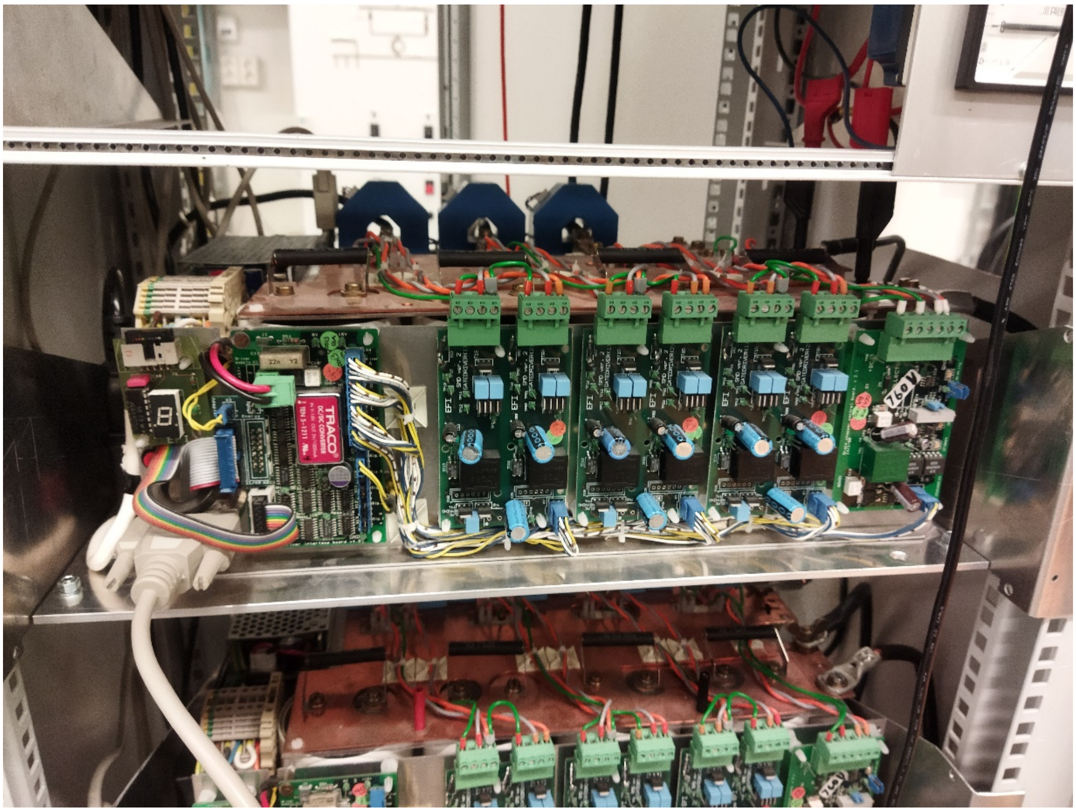

Figure 8: Driver circuit of inverter-1

3.2.1 Real time platform based on OPAL-RT power electronics converters

The designed model was developed on simulation platform using MATLAB/Simulink. Post simulation, based on the real time validation for the proposed model, conclusions are drawn and the developed algorithm will be adopted for the realizing the inverters and motors.

3.2.2 Analysis, measurement, testing and rapid prototyping of power electronics equipment

As this project proposes to develop an algorithm for robust control of EV and test the performance indices of dual inverter fed drive system, a power electronic testing facility is implemented to develop and deploy the advanced inverter functions. Further to develop a prototype of the proposed model, a rapid prototyping infrastructure was fabricated is established.

3.2.3 Power quality testing/ac drive testing infrastructure

This project focuses on the OEWIM drive based EV, hence a test bed comprising of ac drive with suitable loading arrangement along with power quality measurement equipment were used for analysis and interpretation of the obtained results

4 Results and Conclusions

4.1 Discussion of Results

The efforts outlined in this proposal will directly impact the national as well as international needs for promoting the use of EVs over IC engines. This research investigates the need and possibilities in improving OEWIM drive control methodology adopted for EVs to help improvise system efficiency, reduce cost as well as maintaining the torque. Furthermore, with the proposed topology significant change in the environment is possible with the reduction of fossil fuel usage and CO_2 emissions.

This research will provide a way for tangible improvements in the participation of electric vehicles as a mode of transport fulfilling the environmental concerns as well as motivate the use of green power as an alternate energy source. The research outcome of this project is expected to encourage the common public to switch over to EVs, which give a definite push towards the smart utilization of electrical energy. Further, the outcome of this project indirectly reduces the dependency on centralized power stations or grid, reduction in greenhouse gas emissions and more importantly the ability to serve the increasing demand, even to remote places which are common goals of power utilities or Governments across the globe. The outcome of this research can be used in establishing autonomous EVs with a four-wheel-drive which will encourage more researchers in the field of driverless EVs. Besides, this work helps to devise critical co-ordinated control philosophies for the stable operation of EVs. Further, sharing the knowledge base through publishing the projects in national/international journals, and by organizing national/international workshops/seminars. This work also makes paths to address the other issues in the area of boosting the usage of EVs for travel with uninterrupted breaks in charging.

4.2 Conclusions

4.2.1 Impact of Proposed Research:

As a whole, this project aims at secure, reliable and efficient control methodology for OEWIM drive based EV. This results in optimal usage of energy resources and reducing the green house gas emissions which is closely aligned with the objective of European Commission's The Energy Union's Strategy [1 and 2] and the goal of India's Energy Policy [3 and 4]. Successful execution of this project can influence the existing system set-up in the following ways.

4.2.2 Technical Impacts:

a) Efficient and effective speed control of OEWIM drive based EVs.
b) Quick and optimal control of torque without compromising on power loss.
c) System loss minimization and regenerative braking offers higher efficiency of EV.
d) Lesser operating voltage enhances the safety of the EVs.
e) Lower maintenance cost and improved driving experience due to the rugged motor construction.

4.2.3 Socio-Economic Benefits:

a) Cheap running and maintenance cost.
b) Decarbonising the power generation as more than 75% of generated power is transferred to wheels in EVs.
c) With improved reliability in electricity supply, the improved quality of life with more security can be assured to citizens
d) Improves the EV manufacturing capacity, employment and healthy-competitiveness among the stake holders.

4.2.4 Advantages:

a) Reduced power consumption for operating EV, which in turn reduces the pollution. This is highly inclined and in tune with the European Union Energy Policy.
b) Significant cost reduction due to less power rated equipment.
c) Profit maximisation/operational cost minimization of EVs.
d) System loss minimization thereby improving the operational efficiency of EVs.
e) Improves the overall power system reliability by optimal scheduling of various power sources.
f) Offers energy efficient and effective use of renewable energy sources
g) Lesser operating voltage enhances the safety of the EVs.
h) Improves the EV manufacturing capacity, employment and healthy-competitiveness among the stake holders.

5 Open Issues and Suggestions for Improvements

During the execution of the project, two open-end winding induction motors were used to test the operation of this topology. The motors showed good response up to 25% of rated speed, however the set up suffered from tripping of the inverter protection circuits above 25% of the rated speed. This is because of the inherent voltage vectors which disallows the operation during higher speeds. This could be overcome by the use of co-ordination controllers for the three inverters.

I, Dr. Srinivasan Pradabane in capacity as a User Group Leader appreciate the European Commission for taking the initiative to organize the transnational access to key European laboratory infrastructure and research facilities through the H2020 Research programme via ERIGrid 2.0 project. I sincerely thank the co-ordinator of the project Dr. Thomas Strasser, AIT. Thank you very much!

During September and October 2022, myself and my colleague Dr. Chandrasekhar Yammani had the opportunity to be a part of the ERIGrid 2.0 Project Transnational Access program as a guest researcher at National Smart Grid Laboratory, SINTEF Energy Research (NTNU Campus), Trondheim, Norway. We worked towards the real-time validation of our proposed framework for "A fuzzy logic based efficient and robust control of EVs with open-end winding induction motor drive (FLEVOEWIM)". We appreciate the support from SINTEF Energy Research lab colleagues for facilitating and providing excellent infrastructure such as office space and lab equipment to carry out the project. Special thanks to Dr. Merkebu Zenebe Degefa, Dr. Salvatore D'Arco, Mr. Kjell Ljøkelsøy, Mr. Henning Taxt, and Ms. Anne Jegthaug.

Last but not the least, Transnational access makes ERIGrid 2.0 Project a global platform even for the researchers outside Europe for fostering Smart Grid research and lowering carbon footprints.

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Appendix A. Document Guidelines

A.1. Report Titles

Reports have a title that is defined in the submitted LA UP proposal. Please stick to the officialspelling.

A.2. File Naming

The project will generate many documents (reports) and versions of these reports. It is beneficial to consistently use an agreed file naming format.

ERIGrid2-Report-Lab-Access-User-Project-AccessProjectNumber-AccessProjectAcronym-Status-vn.n.Extension

- Notice the hyphen between the various elements of the file name.
- **ERIGrid2**: Each ERIGrid 2.0 report should be preceded by the project acronym. Notice, there is only one correct spelling of the acronym, i.e., ‘ERIGrid 2.0’, but for file names ’ERIGrid2’ will be used.
- **AccessProjectNumber**: This should be based on the formal LA UP number according to the submission system
- **AccessProjectAcronym**: This should be based on the formal LA UP acronym as stated in the corresponding, submitted proposal.
- **Status**:
  - *draft* = Draft Version – indicates that the drafting of the report is in progress;
  - *final* = Final Version as checked and updated by the User Group (UG) and the hosting institution;
  - *submitted*= submitted version as submitted to the ERIGrid 2.0 Project Coordinator (CO).
- **vn.n**: The version of the report starting from v1.0.
- **Extension**: File extension, e.g., ‘docx’ for Microsoft Word and ‘pdf’ for Portable Document Format.

Examples:

- ERIGrid2-Report-Lab-Access-User-Project-116-GRIDPV100-draft-v1.2.docx
- ERIGrid2-Report-Lab-Access-User-Project-116-GRIDPV100-submitted-v1.8.pdf

A.3. Change Log

The Change Log is there to keep track of the changes made to the document. Wheneverchanges are made to the document, a new version should be created and the changes shouldbe briefly summarised in the Change Log. We anticipate a minimum of three phases of ChangeLog entries. (1) The researcher responsible for the given report enters the changes as he/shedevelops the document. (2) The two reviewers register the changes made in the quality assurance phase. Once the responsible researcher passes the report on to the hosting institution,the status should be changed from 'draft' to 'final'.

A.4. Document Formatting

A.4.1. Headings

Like in many journals and books, it is a good practice not to use more than 3 levels of headings.If you really need more, then by all means do so, but you may first consider how to structurethe document with a maximum of three heading levels.

Use the following capitalisation style for all headings: All terms should be capitalised and donot use a full stop at the end.

A.4.2. Captions and Citations

Use the following for captions and cross referencing:

- 'Table 1' for tables, not 'table 1' or 'Tab. 1', etc.
- 'Figure 1' for figures, not 'figure 1' or 'Fig. 1', etc.
- 'Section 1.1.1' to cross-reference other sections, not 'section 1.1.1' or 'S. 1.1.1', etc.

Do not abbreviate the word 'Equation' to 'eq', 'Eqn', etc.

Table captions should be placed above the table and figure captions should be placed belowthe figure. The captions should succinctly describe the content of the table or figure.

A.4.3. Tables

Producing informative tables is not easy. Avoid grid lines around each table cells (typical forpeople with little experience in drafting technical papers). The table below (Table 1) is a goodexample how tables should look like. Make sure that caption appears on the same page as thetable. The table caption is above the table!

The table caption should follow the sentence style layout and end with a full stop. The captionas well as the table should be centred.

Each table must be introduced in the deliverable text. Make sure that cross references to tablesare correct before submitting the deliverable.

The same (simplified) table using theWord table feature is shown below (Table 2).

A.4.4. Figures

Good figures/diagrams are even more difficult to produce than tables. Figures should containlegends explaining the symbols in the figure. Avoid surrounding the figure with a box outline.If there are different parts of a figure (e.g., (a), (b), (c)), indicate these clearly. Make sure thatthe labels within a figure/diagram are spelled consistently within the figure/diagram and arealso consistently spelled in the text. Make sure that caption appears on the same page as thefigure. The figure caption is below the figure. See an example of a figure and its caption below(Figure 1).

Table 1: Summary of properties of different modelling formalisms. The table below is inserted as graphic.

	Static (s), dynamic (d)	*Discrete (d), continuous (c)*	*Deterministic (d), stochastic (s)*	*Qualitative (ql), quantitative (qn)*	*Coarse (c), average (a), fine (f) grained*
DG	s		d	ql	c
BYN	s[a]	d,c	s	qn	c
BNN	d	d	d	ql	c
GLN	d	d	d	ql	a
NLDE	d	c	d	qn	a,f
PLDE	d	c	d	ql,qn[c]	a
QDE	d	d	d	ql	a,f
PDE	d	c[b]	d	qn	a,f
SME	d	d	s	qn	f
R	d	d	d	ql	a,f

[a]Generalization to dynamic Boolean networks is possible.
[b]Spatial dimension is often discretized.
[c]Qualitative analysis of models is possible.

Table 2: Summary of properties of different modelling formalisms.The table below is produced using-Word table environment.

	Static	Discrete	Determinis-tic	Qualitative	Coarse
DG	s		d	ql	c
BYN	s	d,c	s	qn	c
BNN	d	d	d	ql	c
GLN	d	c	d	qn	a,f

Each figure must be introduced in the deliverable text. Make sure that cross references tofig-ures are correct before submitting the deliverable.

The figure caption should follow the sentence style layout and end with a full stop.The fig-urecaption as well as the figure should be centred.

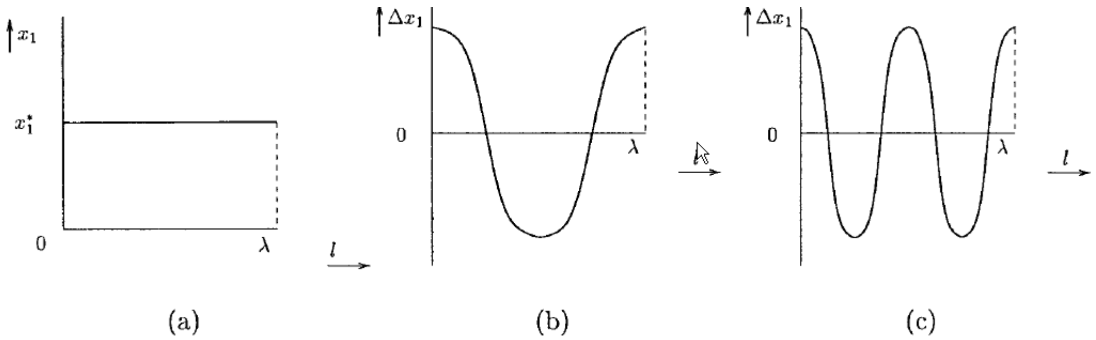

Figure 1: Caption captioncaptioncaptioncaptioncaptioncaptioncaptioncaption. (a) Caption cap-tioncaption, (b) Caption captioncaption, (c) Caption captioncaption.

A.4.5. Footnotes

This[1]is a footnote.

[1]The footnote is at the bottom of the same page where the footnote is cited and the font size is only 9 pt.Foot-notes are useful to for including nasty-looking long Web references which would look terrible if used in the mainflow of the text.

A.5. Language and Notation

There are a few things we should consider when writing documents in terms of language. Thequestion is not deeply philosophical in the sense of whether one or the other approach is fundamentally correct (or wrong). It is more the case of maintaining a certain level of consisten-cyacross the project.

Since British/UK English is the official version of English within the European Commission (EC),we should by default use UK English spelling (and adopt a spell-checker set to UK English).Nevertheless, US spelling is also fine — the main issue to ensure is to be consistent within agiven deliverable.

Quotation marks.UK English (unlike US), use single quotation marks (‘X’) instead of double-quotation marks (“X”). At least maintain consistency within a document.

- It is claimed that Y is ‘superior’ to X.
- ‘Good morning, Dave,’ greeted HAL.

Do not use quotation marks to indicate emphasis — use italics, bold or underline style instead.

The accepted standard for separating orders of magnitude in large figures is not ‘,’ or ‘’’ (quotation mark) or ‘.’, but a non-breaking (small) space.

- This is inappropriate: 1,000,000 or 1.000.000 or 1’000’000 (very bad!)
- This is good: 1 000 000.

Capitalisation. Use capitalisation according to English grammar rules. If someone is interested,see capitalisation rules:[2]

Tense. Use past tense when describing activities and tasks (experiments, developments, etc)carried out in the past.

- A test bed was set up to …
- The evaluation revealed that …

Use present tense when describing the ideas, design, systems, etc. that exist in the present.

- The system supports the following exchange formats …
- A key property of the system is its ability to …

Large numbers. Use explicit format or scientific notation for large numbers

- Use 1 200 000 000, not 1.2bn or 1,200,000,000
- Or use 1.20 10^9or 1.20 × 10^9

Small numbers. As usual, unless in tables and similar elements, use one, two, …, twelve for-numbers < 13, and 13, 14, …, for large numbers.

Numbers and units. Use space to separate figures from units. E.g.,

- 10 GB, not 10GB
- 2.13 s not 2.13s

[2]http://andromeda.rutgers.edu/~jlynch/Writing/c.html, http://www.grammarbook.com/punctuation/capital.asp

Bits, bytes and pieces. Use the following terms and abbreviations for bytes (sometimes it isbet-ter to use the full term than the abbreviation).

Bits:

kb or Kb	kilobit	103
Mb	megabit	106
Gb	gigabit	109
Tb	terabit	1012

Bytes:

kB or KB	kilobyte	103
MB	megabyte	106
GB	gigabyte	109
TB	terabyte	1012

Number of decimals. When a number is expressed in the scientific notation, the number ofsig-nificant digits (or significant figures) is the number of digits needed to express the number towithin the uncertainty of calculation. For example, if a quantity is known to be 1.234±0.002,four figures would be significant[3].

Unless there is a good reason, do not use more than three fractional digits or places (the-number of digits following the point).

Other issues. Avoid overly long sentences. Certain rules suggest that sentence over approxi-mately 20 words become difficult to understand and should therefore be avoided.

A.6. Formatting Bibliographical References

By default, references should use APA style (as, e.g., used in Google Scholar) and be or-deredin alphabetic order. See for example(Tan, Kumar, & Srivastava, 2004), in the list below.

Other styles are also OK, nevertheless the authors should make sure that within a single doc-ument the notation to references and their citation should be consistent. In the text, the refer-ences should ideally be referred to by the author name and year, e.g., (Lamport, 1994); how-ever, referencing by reference number is also acceptable.

A.7. Associated Outputs

If appropriate, please include a section with details of any datasets, code or other resourcesbe-ing released with this report.

The work described in this report has resulted in the following resources:

Description	URL	Availability
My Dataset 1	http://hdl.handle.net/12345	Public (Apache 2.0)
My Dataset 2	http://hdl.handle.net/54321	Private (consortium only)
My Code	github.com/erigrid2/xxx	Public (GPL3)

[3] http://mathworld.wolfram.com/SignificantDigits.html

AppendixB.Heading

B.1. Heading

TODO:“Explainthecontentoftheappendix.”

B.2. Heading

TODO:“Explainthecontentoftheappendix.”

AppendixC.Heading

C.1. Heading

TODO:“Explainthecontentoftheappendix.”

C.2. Heading

TODO:“Explainthecontentoftheappendix.”

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