HUNGARIAN UNIVERSITY OF
AGRICULTURE AND LIFE SCIENCES

27th Workshop on Energy and Environment

December 9-10, 2021, Gödöllő, Hungary

Book of Abstracts

Editors: István Farkas
Piroska Víg

Gödöllő, 2021

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Editors

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Dr. Piroska Víg PhD (Institute of Mathematics and Basic Science)

Reviewers

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Dr. István Seres PhD (Institute of Mathematics and Basic Science)

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PREFACE

Successful events in the series of the Seminar/Workshop on Energy and Environment (EE) were organised yearly since 1995 under the auspices of the Department of Physics and Process Control, Institute for Environmental Engineering Systems, Szent István University Gödöllő, Hungary (recently Department of Physics, Institute of Mathematics and Basic Science and Department Mechatronics, Institute of Technology, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary), including active participation also from foreign institutions working in the field of the application of renewable energy resources.

The aim of the Workshop is to provide a forum for the presentation of new results in research, development and applications in connection with the issues of energy and environment.

This is now a call to take part in the abovementioned event along with to submit one page abstract of potential contributing papers falling into the Workshop topic. The Abstract Volume of the Workshop will be published and distributed among the participants during the event. The language of the Workshop is English, no simultaneous translation will be provided.

In this year, depending on the actual pandemic situation the Workshop is organized on-line way via the Google Meet link of: https://meet.google.com/uhy-jrfr-ppm

The deadline of the abstract submission: December 3, 2021

Further information, please, contact:
Prof. I. Farkas
Founding Chairman of the Workshop
Institute of Technology
Hungarian University of Agriculture and Life Science
Páter K. u. 1., H-2100 Gödöllő, Hungary
E-mail: Farkas.Istvan@uni-mate.hu Tel: +36 28 522055 http://fft.szie.hu/ee2021.html

NANOFLUIDS IN SOLAR FLAT PLATE COLLECTORS: THERMOPHYSICAL PROPERTIES AND LIMITATIONS

Ahmed M. Ajeena[1], P. Víg[2], I. Farkas[3]

[1]Doctoral School of Mechanical Engineering, [2]Institute of Mathematics and Basic Science, [3]Institute of Technology
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 70 7197843, E-mail: ahmedm.dhayea@uokufa.edu.iq

Solar energy is widely regarded as the ultimate solution to the world's ever-expanding energy crisis. Different solar energy conversion systems have been used to produce the desired application form of solar energy. Solar energy systems are chosen to be one of the most effective alternatives to traditional fossil fuels due to their ability to convert solar energy directly into heat and electricity with no negative environmental impact. In solar thermal systems, flat plate solar collectors (FPSCs) are the most commonly used type in low thermal applications such as space heating, space cooling, solar water heating, and industrial process heating. The main factor impacting the thermal performance and efficiency of the Flat plate solar collectors is the low thermal conductivity of the working solar fluid. Hence, there is a need to improve the properties of the solar fluid in these collectors.

Researchers are increasingly turning to nanotechnology as the most recommended option for solving this problem, which has overgrown in recent years. Nanotechnology is currently attracting a great deal of attention, and as a result, there are high expectations among the academic community and industry. Nanofluids are a new development of heat transfer fluids that have drawn the attention of researchers from a variety of fields because of their unique thermal properties and potential applications. It has been found that substituting traditional fluid with nanofluid improves thermophysical properties such as thermal conductivity. The application of nanofluids in a flat plate solar collector (FPSC) effectively improves collector performance.

This study has been divided into two parts: the first part presents the thermophysical properties of nanofluids such as density, thermal conductivity, viscosity, and specific heat, which the addition of nanoparticles into the traditional solar fluid in solar collector leads to changes in thermophysical properties that affect the heat transmission coefficient. The second part focuses on the main limitations of nanofluids, such as that instability, viscosity, size of nanoparticles, corrosion, concentration limit, and cost of nanofluids, and the agglomeration of nanoparticles that effect, which could be beneficial for all new researchers of this field.

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EFFICIENCY COMPARISON BETWEEN THE POLYCRYSTALLINE AND THIN-FILM PV MODULES

Mensour Almadhhachi[1], I. Seres[2] and I. Farkas[3]

[1]Mechanical Engineering Doctoral School, [2]Institute of Mathematics and Basic Science
[3]Institute of Technology, Hungarian University of Agriculture and Life Science
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail: Al-Madhhachi.Mensour.Saheb.Malek@phd.uni-mate.hu

There is a global movement toward alternate and sustainable energy sources, particularly solar energy because it is the most critical source of clean energy for reducing harmful pollutants and noise. One of the essential sources of solar energy is photovoltaic cells, and there are three main types of it (monocrystalline, polycrystalline and thin-film).

Polycrystalline was chosen to compare with the thin-film because of the similarity between mono and poly cells. On the other hand, the convergence between the efficiency of polycrystalline with thin-film ranges (14-16%) and (11-15%), respectively.

The comparison was made in the Solar Energy Laboratory of the Hungarian University of Agriculture and Life Sciences. The readings were taken on a partly cloudy day to determine the efficiency and the effect of clouds on the production of electrical energy.

Polycrystalline solar cells have been widely spread for a long time, and they are considered one of the cells distinguished by their strength and longevity. Therefore, many power stations have used them to generate electricity. In addition, they are characterized by a low maintenance rate and few breakdowns, while thin-film solar cells were used at the beginning of the 21st century. On the other hand, they are considered the least efficient cells among the types of solar cells. Still, they are characterized by their ability to bend, which gives them essential advantages by covering many shapes and thus converting the bodies into generators of electricity, it is worth mentioning that this type of solar cell has been used in many advanced applications and therefore because of its lightweight and ability to bend.

Among the laboratory results obtained, it was found that there is an excellent convergence in the shape of the efficiency curve resulting from both types of solar cells. As for the effect of clouds, the consequence was apparent on Both types, the impact of clouds on energy production was inversely proportional with the intensity of the clouds, in other words, a decrease of the sun's radiation.

One of the advantages of solar cells tracking the momentary change of solar radiation is the similarity between the solar radiation and the production curves for polycrystalline and thin-film modules, which makes the beneficiary fully convinced in choosing the type of solar cells to meet the investor's requirements.

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ENHANCEMENT THERMAL EFFICIENCY OF PTSC BY USING NANOFLUID

A.Y. Al-Rabeeah[1], I. Seres[2], and I. Farkas[3]

[1]Doctoral School of Mechanical Engineering, [2]Institute of Mathematics and Basic Science [3]Institute of Technology
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail: asaadyasseen@gmail.com

The parabolic trough solar collector (PTSC) is the most widely used concentrating solar technology in the world. The traditional PTSC is used in a variety of low- and high-temperature applications. PTSC consists of a reflective surface, an absorber tube, and a working fluid that passes through the tube. An absorber tube is located at the focal line or focal point of the reflectors.

PTSC absorbs solar radiation and converts it to heat energy, which can be used to heat water, air, or oil. Working fluid thermal energy can be used for several applications. In PTSC, working fluid is one of the most important elements in the photothermal conversion process. The high photothermal efficiency of the fluid greatly depends upon its thermophiscal properties.

The aim of this research is to increase the thermal efficiency of PTSC by using the nanofluid as a working fluid. Furthermore, it remains to be studied how the working fluid effects the heat transfer collector. Because of its superior thermophysical properties compared to conventional working fluids like water, ethylene glycol, and oil, nanofluid has gained attention as a new and efficient heat transfer fluid.

There are two primary methods for preparing nanofluids: the one-step method preparation process and the two-step method preparation process. The one-step procedure creates and disperses particles in fluid. This method avoids dispersion, transport, storage, and drying of nanoparticles, reducing agglomeration and boosting fluid stability. The two-step method involves two steps: producing nanopowder and dispersing it in a base fluid. Firstly, nanopowder is obtained through inert gas condensation, chemical vapor deposition, or mechanical alloying. Then the nanopowder is mixed with the base fluid using ultrasonic agitation.

Mixing of nanoparticles to the working fluid is an effective method to increase the thermal energy collected and the thermo-physical properties of nanofluid such as the enthalpy, specific heat capacity, thermal conductivity and density

Furthermore, different nanofluid types are being examined to optimize the performance of PTSC. Therefore, advanced composites (new nanofluid types) for better heat transfer and enhanced absorptivity need to be explored.

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This work was supported by the Stipendium Hungaricum Programme and by the Mechanical Engineering Doctoral School, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary.

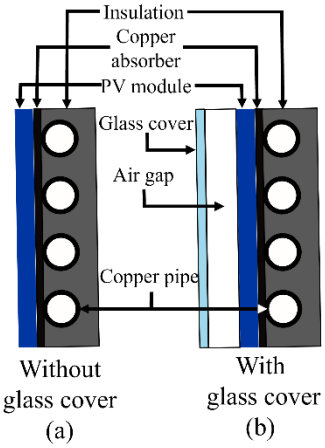
GLASS COVER EFFECTS ON PERFORMANCE OF THE HYBRID SOLAR COLLECTOR SYSTEMS

Ahssan M.A. Alshibil[1], P. Víg[2] and I. Farkas[3]

[1]Doctoral School of Mechanical Engineering, [2]Institute of Mathematics and Basic Science, [3]Institute of Technology
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
E-mail: Al.Shibil.Ahssan.Mohamed.Ali.Karem@phd.uni-mate.hu

The hybrid photovoltaic/thermal (PV/T) technology creates electricity and thermal power from absorbed solar energy at the same time. The benefits of a PV/T system are that it reduces the needs on equipment costs and physical space, as opposed to separate solar thermal and PV systems put side-by-side in a conventional solar system.

Thermodynamic behaviour is the most significant factor in the hybrid solar thermal collector systems (PV/T), which starts from the environment into the PV/T layers. As shown in the figure below, some PV/T modules are designed and structured with and without a glass cover. This study examined the impacts of the glass covering on the thermal and electrical performance of the hybrid solar collector.



This study uses the features of the PV/T module consisting of a copper plate as a solar collector and a Mono–Crystalline PV module and builds it with TRNSYS software to evaluate the entire system. This investigation aims to assess the performance of a suggested system of the PV/T collector through two cases, with and without glass cover.

The findings also reveal that the electrical efficiency of the PV/T system without a glass cover is greater than that of the PV/T system with a glass cover; the PVT system without a glass cover is recommended when electrical energy is the primary concern. In contrast, PV/T systems with glass covers are recommended if higher thermal efficiency is desired.

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THERMAL PERFORMANCE OF BUILDING ENVELOPE INTEGRATED WITH PHASE CHANGE MATERIAL IN A HOT REGION

Q. Al-Yasiri[1], M. Szabó[2]

[1]Doctoral School of Mechanical Engineering, [2]Institute of Technology
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 30 6580535, E-mail: qudamaalyasiri@uomisan.edu.iq

Buildings in hot regions suffer from high heat gain in the summer, resulting from high outdoor solar radiation and ambient temperature. Therefore, the thermal comfort of occupants cannot be met without using high-performance air-conditioning systems. These systems are high energy consumers causing a shortage in the power supply. Amongst effective methods to minimise building heat gain, integrating phase change materials (PCMs) with building construction has recently attracted much attention by researchers due to their ability to maintain a better indoor environment.

The thermal behaviour of building envelope integrated PCM was experimentally conducted on a hot summer day in Iraq. Two rooms (1 m^3) were built in which one integrated with PCM in the roof and walls and the other without PCM for control, as illustrated in Fig. 1. Both rooms were tested on 17th September 2021 in Al Amarah, southern Iraq. This city is one of the hottest regions in Iraq and the Middle East in which the ambient temperature and solar radiation in summer months often exceed 50 °C and 1200 W/m^2, respectively.

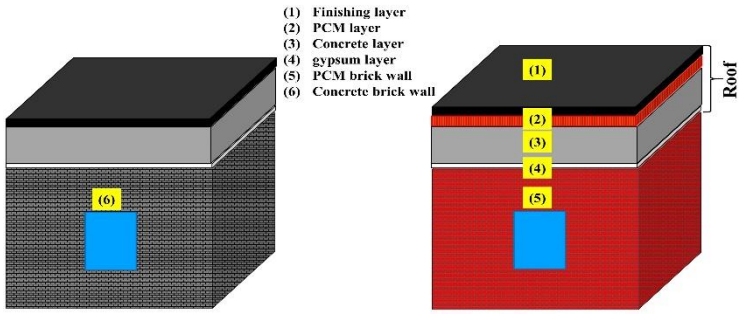

Fig. 1. Experimental PCM room (right) and control room (left)

Results showed that the temperature was lower and more stable in the PCM room elements (i.e., PCM roof and walls) than in the control room. Moreover, the indoor air temperature in the PCM room was decreased significantly compared with that in the control room during daytime hours. The eastern wall showed the highest temperature reduction in the PCM room compared with the other walls. Besides, the roof was the most element that decreased the temperature and heat gain compared with all walls. These two elements (i.e., the eastern wall and roof) significantly influenced the indoor air temperature by more than 60%.

The study also witnessed a revered temperature behaviour of PCM room during nighttime due to the discharged heat stored that kept PCM elements with high temperatures. Subsequently, proper night ventilation should be considered to extend the PCM positive energy contribution.

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HYDROGEN ROLE IN THE DECARBONISATION OF THE EUROPEAN ECONOMY AND NEW FEEDSTOCK FOR ITS SUSTAINABLE PRODUCTION

S. Bartha[1], L.C. Duarte[2], F. Carvalheiro[2]

[1]BIO-C-ECOIPAR LTD, 10-Castanilor Street, Ro- 520004, Sf. Gheorghe, Romania
Tel: +40 722250725, E-mail: sbarthacv@yahoo.ro
[2]LNEG – Laboratório Nacional de Energia e Geologia, Unidade de Bioenergia e Biorrefinarias, Estrada do Paço de Lumiar, 22, 1649-038 Lisboa, Portugal
Tel: +351 210924713, E-mail: luis.duarte@lneg.pt

According to the "European Green Deal" published in January 2020, the EU aims to be climate neutral - an economy with net-zero greenhouse gas emissions - by 2050. This was further strengthen this year with the setting of an intermediary target to 2030 under the "Fit for 55" package (2050 long-term strategy (europa.eu); EU economy and society to meet climate ambitions (europa.eu)). These political determinations impose a significant drive for restructuring the European energy-production sector, both on:

i. the use of sustainable resources; and
ii. to produce sustainable energy carriers. In this framework, the role of the hydrogen-based economy is very significant.

The current hydrogen production processes are still mainly based on fossil resources, either by coal gasification (*Black/Brown Hydrogen*) or most noteworthy natural gas by steam methane reforming (*Grey hydrogen*), the current industrial standard, with both technologies producing significant greenhouse gases (GHG) emissions. Alternative processes include the *Blue Hydrogen* approach that couples *Grey Hydrogen* production with Carbon Capture and Storage technologies, *Pink Hydrogen* for the electrolysers supplied by electricity from the nuclear power plants, and the *Green Hydrogen* produced by electrolysers supplied by renewable electricity. Green Hydrogen can also be used to designate the more commonly referred as Bio-Hydrogen, hydrogen produced through biological pathways and/or using biological resources , such as biomethane reforming or biomass gasification, among others, that can reach negative GHG emissions.

This paper evaluates the development of a new technology concept based on a biorefinery model, where the green hydrogen is produced from seaweeds, based on an alkaline thermal treatment (ATT) technology. The used feedstock in this process is *Ulva rigida* largely available in the Romanian Black Sea Coast, where algae blooming are frequent and greatly disturb the touristic activity, as every year, in particular during summer period, more than 30-40 tonnes algae are collected, and stored in local waste landfill deposits, where its natural degradation produces high GHG emissions.

A thorough analysis of the most relevant technical aspects will be presented, taking special attention to the biomass pre-treatment processes, and the possibility to recover added-value products from this stage. Finally, a preliminary economic analysis is presented based on model developed for the material (stoichiometric) and energy balances.

Acknowledgements

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HYDROGEN POLICY POTENTIALS IN THE COUNTRIES OF THE VISEGRAD GROUP

Sz. Csányi, H. Zsiborács, G. Pintér, A. Vincze,
N. Hegedűsné Baranyai

Renewable Energy Research Group, Soós Ernő Research and Development Center,
University Center for Circular Economy, University of Pannonia Nagykanizsa,
Zrínyi Miklós u. 18., Nagykanizsa, H-8800 Hungary
Tel.: +36 30 1081768, E-mail: Csanyi.Szilvia@uni-pen.hu; baranyai.nora@uni-pen.hu

Hydrogen is expected to play an important role in the sustainable supply systems based on renewable energy sources of our future. Its use provides an opportunity to integrate our weather-dependent renewable energy sources (wind and solar energy) into the electricity systems more efficiently. Most research does not point towards road or sea transport, but is aimed at transporting hydrogen in pipelines. The most popular version of this solution is when hydrogen is injected into the natural gas network to transport it thusly from the site of production to the location of consumption. This solution has spread because, if society follows the path of carbon neutrality and fossil energy sources are not used in the future, the existing gas network will not be left unused in this way. While using weather-dependent renewable energy sources, no CO_2 is released when hydrogen is burned, thus feeding hydrogen into the natural gas network results in lower CO_2 emissions during end-use. If the production of hydrogen is done in a low-carbon manner (by steam methane reforming (SMR) with CO_2 capture and storage, or by electrolysis with 'green' electricity), it may result in a reduction in total CO_2 emissions.
Due to the beneficial properties of hydrogen, its local potentials in terms of production, transport and use as well as their economic feasibility are being explored throughout Europe. For this reason, several EU Member States already have their specific hydrogen strategies. Currently, most hydrogen strategies focus on the production of so-called green hydrogen and technological development.
This study presents the hydrogen production and use plans and potentials of the countries of the Visegrad Group. The aim of the review is to highlight the role that a potential cooperation in the field of hydrogen technology could play in each country, and how such cooperation can be successful and beneficial to all parties.

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AN ALTERNATIVE IMPROVEMENT OF GEOTHERMAL POWER PLANT – IN A CASE STUDY: INDONESIA

S. Daniarta[1,2], A.R. Imre[2,3], P. Kolasiński[1]

[1]Department of Thermodynamics and Renewable Energy Sources, Wrocław University of Science and Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland
[2]Department of Energy Engineering, Budapest University of Technology and Economics, Műegyetem rkp. 3, H-1111 Budapest, Hungary
[3]Department of Thermohydraulics, Centre for Energy Research, H-1525 Budapest, Hungary
E-mail: sindu.daniarta@pwr.edu.pl, daniarta@energia.bme.hu

Indonesia is diversifying and increasing its power production capacity to meet the increasing energy demand, nevertheless, fossil-fuel-based power generation (e.g., coal, oil, and gas) is still dominated (Nasruddin, 2016). Nowadays, rising energy and environmental consciousness have increased interest in renewable-based power generation from various sources. One of the renewable-based sources is geothermal heat. Indonesia, which is placed on the Ring of Fire, has this abundant geothermal heat sources that can be utilized as a power generation. To extract the heat from the geothermal sources, the chain is similar to oil and gas production, starting with exploration, exploitation, and production. Nevertheless, the strategy within the case of distribution is different. For the geothermal sources, the heat – due to the transportation losses – is advised to be directly utilized at (or very close to) the well. Organic Rankine cycle (ORC) – a process similar to steam cycles, but using organic working fluids instead of water - is one of the promising solutions to utilize geothermal heat. For this reason, research on this field has been very intense in the last few years.

Optimization of geothermal heat-based ORC may help this country accelerate the development of more renewable and clean-based power generation solutions. However – being Indonesia a country with numerous islands, separated by wide straits – long-distance energy (electricity) transport is difficult. There are two alternatives for the long-distance energy transport that may be implemented for Indonesia, such as subsea grids (direct way) or power-liquid-power technology (indirect way) (Daniarta and Kolasiński, 2021).

In this presented study, the aim is to advance the existing geothermal power plants in Indonesia with the help of cold energy utilization. It demonstrates that the result can enhance the efficiency of the existing power plant and additional solutions, such as waste management and a rise in the competitiveness of the geothermal energy industry, may be implemented.

Acknowledgement

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Daniarta S, Kolasiński P.: An integration of geothermal energy, waste, and cold energy system employing the technology of organic Rankine cycle. Wieland C, Karellas S, Quoilin S, Schifflechner C, Dawo F, Spliethoff H, editors. Proc. 6th Int. Semin. ORC Power Syst., Munich: Technical University of Munich; 2021.

NEW APPLICATION APPROACHES IN THE FIELD OF SOLAR PHOTOVOTAIC TECHNOLOGIES

I. Farkas

Institute of Technology, Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail: Farkas.Istvan@uni-mate.hu

This paper is dealing with the new application possibilities of the rapidly developing field of solar photovoltaic technologies. An overview is given on the new worldwide actualities and developments on the field of solar photovoltaic (PV) energy use. Both, the solar cell and module technologies are to be discussed including their introduction possibilities and applications.

The worldwide situation is analysed based on the topic touched upon at the EuroSun 2020 Solar Conference organized online in Athens, Greece in 2020, and also at the Solar World Congress (SWC 2021) organised online by the International Solar Energy Society in 2021. Additionally, the most recently published books in this topic serve information overviewing the recent statements.

In 2019, the solar PV market increased by 12% reaching the global capacity of 627 GWpv along with the record of annual additions of 115 GWpv, which is equivalent to the energy production of about 47 thousand modules every hour.

Due to mainly photovoltaics technology, the distributed renewables for energy access becoming effective, and benefited about 150 million people around the world in 2019. The market for off-grid solar systems grew 13% in that year.

Concerning to the PV application development it is also a significant fact that the number of electric vehicles is getting increase. In 2019 around 7.2 million electric cars were on the world's roads. There are some countries having a national plan to reach the 100% electric vehicle target.

Putting into operation more solar plants is approaching to drive down the price of solar electricity.

In case of large-scale ground-mounted plants there are concerns about the environmental impacts and agricultural lands. The floating PV projects continues their rapid expansion. Further new market segment is emerging such as agri-PV which is the combination of PV with agriculture.

At the same time, strong research activities are conducted to reach more efficient cell technologies, for instance Perovskites, in tandem with crystalline silicon or thin-film base. There are projects focusing on the long-term stability of Perovskites. In the laboratory, the high concentration multi-junction solar cells achieved an efficiency of 47.1%, and modules with concentrator achieved 38.9%. In 2019 the modules' price dropped by around 12% to the world average of 0.36 USD per Watt. At module level it is intended to develop higher power ranging at 400 W-plus mainly for building applications.

INDOOR POLLUTANTS FROM OLD AND NEWLY BUILT HOUSES

L.R. Fekti[1], G. Géczi[2], L. Székely[2]

[1]MVM Paks Nuclear Power Plant Ltd., [2]Institute of Environmental Science
[3]Institute of Mathematics and Basic Science
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 20 281 1532, E-mail: Laszlo.richard.fekti@gmail.com

Nowadays newly built buildings have to meet strict requirements, existing, old residential buildings have to be modernized. When constructing new buildings and renovating old ones, we can create the most optimal space by setting appropriate temperature, humidity and air quality.
The comfort assessment can be based on the data according to MSZ CR 1752:2000 and the requirements of the MSZ EN 15251 standard. Increasing demand levels brought with it differentiated comfort. Categories „A", „B", „C" can be determined on he basis of comfort levels according to international standards. The best „A" category has the lowest percentage of the expected dissatisfaction. Contaminated air in indoor areas without ventilation is harmful to health. Air quality is determined by several factors and must be treated in complex way:

- carbon dioxide level in the air,
- radon levels,
- evaporation of plastics, paints, chemicals, cosmetics, household cleaners and varnishes, in summary the VOC level of the materials,
- Humidity, which favours the formation of bacteria, viruses, fungi and mold.

The amount of fresh air required can be determined in three different ways according to the MSZ CR 1752:2000 standard:

- based on the floor area of the room,
- based on occupants,
- based on indoor air quality.

In the case of design, the calculations must be performed according to all three methods. According to the standard, from the quantities of fresh air, the one with the highest value must be chosen. The system, air handling units, fan must be selected and dimensioned so that calculated flow rate can be delivered to the destination.

The various measuring devices are extremely expensive, they are extremely expensive to deploy at several locations, but we have been able to save a lot of time and money by using the traceability measurement method, participating in national research and creating a measurement environment. In the course of my research, my goal is to find the optimal number of air changes, avoiding large financial investments.

For the experiments of radion concentration resulting from the ventilation method, three basic cases were investigated:

- „A"- Ventilation with fan, n>2 1/h,
- „B" – Natural airflow n~0,5 1/h,
- „C" – Non ventilated space.

SEMICONDUCTOR-BASED MEASUREMENT METHODS FOR IONIZING RADIATION SENSING

G. Géczy[1] and I. Seres[2]

[1]Doctoral School of Mechanical Engineering
[2]Institute of Mathematics and Basic Science
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail: Geczy.Gabor@phd.uni-mate.hu

Today with the development of technology, more and more information about our world is available, and with the new achievements of measurement technology, humanity can get a more and more detailed picture about our planet and our environment.

Ionizing radiation is present in our environment, and the living organism has adapted to the permissible level. However, in many areas of our lives, in laboratories, hospitals, various factories and in our environment, there is an increasing need to measure, monitor and control the intensity of ionizing radiation due to artificial applications.

Radiation measurement is an extremely complex field where 10-20% measurement accuracy is still widely accepted. There are various methods for detecting and measuring these radiations, traditional and novel ones. The measurement principle can be based on counting the particles and taking into account their effects, the operation of which is based on determining the number of particles, detecting changes of the particles due to the passage through matter, measuring their energy, or e.g. measuring the change in the parameters of radiation-sensitive materials, we can also infer the radiation and its intensity.

Today, there is a growing demand for semiconductor-based instruments due to the proliferation of electronic devices and their many advantageous properties such as small size, reasonable power consumption and the endless possibilities for high-tech portable and remote applications such as space research, nuclear industry, medical applications and others.

The presentation will give an overview of the currently used semiconductor-based radiation sensing methods, and the research possibilities.

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PERFORMANCE OF AN INDIRECT NATURAL TYPE OF SOLAR DRYER

Gedion Habtay[1], J. Buzas[2] and I. Farkas[2]

[1]Mechanical Engineering Doctoral School, [2]Institute of Technology
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail: gedion.habaty@gmail.com

In the present work, an indirect type solar dryer was constructed and installed at the forecourt of the Solar Laboratory of Hungarian University of Agriculture and Life Sciences, Godollo, Hungary. The dryer has three compartments: solar air collector, solar chimney, and drying chamber. The first two compartments were used for collecting solar radiation and producing thermal energy and the last one used for spreading the product to be dried. The solar chimney is studied separately to establish the effect of changing its air gap height (5 cm and 10 cm air gap between glass cover and absorber plate) on thermal efficiency and drying rate (moisture losses). The dryer had two trays for loading the product and each tray were loaded with a 916 g of potato having an initial moisture content of 82.08±0.34%. The solar collector was inclined at a specific angle for absorption of maximum solar radiation while the solar chimney was fixed vertically upward.

The experimental measurements were performed from July to August 2021. Each experiment starts at 09:00 and continued to 17:30. The solar chimney made from a polystyrene material. It is a rectangular shaped with a dimension of 0.5x0.5x0.05/0.1 m length, width, air gap height respectively. A Plexiglas cell casting was used for glazing purpose. The bottom and sides wall (0.05 m thickness) were constructed with EPS polystyrene material (thermal conductivity 0.038 W/m.K). Single wall corrugated (double faced) cardboard was used as absorber, then copper fins were used to make artificial roughness of the solar chimney. The roughness and absorber plate were painted with black enamel paint.

Many parameters are measured during each experiment which are temperature, inlet air velocity, solar intensity, and weight loss of the product across the dryer. A pyronmeter model (Kipp & Zonen-CM11) and solarimeter model Kimo SL-200 were used to measure the solar radiation. A T-type thermocouples were placed at different locations to measure the temperature. The air flow velocity inside the dryer was measured using Testo 405i anemometer. The thermal efficiency of the solar chimney and collector were calculated directly from the data obtained from each solar chimney cases.

The results of this study indicate that the average thermal efficiency of the collector and chimney was found to be 28.5% and 42.4% respectively when using a 5 cm chimney air gap whereas it was found 48.5% and 38.3% for collector and chimney when using a 10 cm chimney air gap. Besides, the total moisture loss from the product was high when using a 10 cm air gap chimney. Finally, it was observed that the temperature of the absorber plate (cardboard) of the solar chimney can reach higher than 70 °C. This result leads for further study in selecting good absorber plates for solar collector.

Acknowledgements

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ESTIMATION AND FORECASTING OF SOLAR RESOURCES BY ARTIFICIAL NEURAL NETWORK

K. Halefom[1], J. Buzas[2], I. Farkas[2]

[1]Doctoral School of Mechanical Engineering, [2]Institute of Technology
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36703000782, E-mail: halek@hu.edu.et

The intermittent and unpredictable nature of renewable energy leads to doubt on reliability and stability of power grid systems and uncertainty of power generation in the near future. Forecasting plays a great role to solve the fluctuating nature of those renewables. Recently artificial neural networks (ANNs) are employed for predicting the fluctuating nature of renewable resources such as solar radiation. In this study ANN approach is used to quantify and forecast solar resource potential in Geba catchment of Northern Ethiopia. The studied sites cover an area of approximately 5133 km^2 and an elevation of 955 m to 3295 m with a mean elevation of 2164 m above sea level and is located between longitude 38°38' to 39°48' East and latitude 13°18' to14°15' North.

The data used in this study was obtained from the Department of Mechanical Engineering at Mekelle University. The data was measured at the height of 10 meters in three locations, Hagere Selam, Mayderhu and Mekelle University. The analysed data contains weather variables including solar radiation, wind speed and temperature for the year 2012 for Hagere Selam and Mekelle University, and 2011 for Mayderhu site.

The analysis of the solar radiation measurement series reveals that the solar radiation varies spatially with more dependence on altitude. The maximum monthly average solar radiation was found to be 6.78 kWh/m^2, 7.08 kWh/m^2 and 6.70 kWh/m^2 for Hagere Selam, Mayderhu and Mekelle University sites, respectively. While the monthly minimum average values were 3.43 kWh/m^2, 3.54 kWh/m^2, and 3.87 kWh/m^2 for the same sites.

In forecasting analysis using ANN the ambient temperature and wind speed were used as input variables. The architecture of the neural network was built with 14 hidden layers and sigmoid activation function with input data categorized into three sets: the training set 70%, the validation set 15% and the testing set 15%. The validation method was conducted using Mean Square Error (MSE) and the correlation coefficient (R). The result of the indicators showed that the predicted values were closely corelated to measured values.

Acknowledgements

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METHOD FOR SELECTING THE LOCATION OF AN EXPERIMENTAL HEAT PUMP INSTALLATION

P. Hermanucz[1], G. Géczi[2], I. Barótfi[1]

[1]Institute of Technology, [2]Institute of Environmental Science
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 30 509 8408, E-mail: hermanucz.peter@uni-mate.hu

The proliferation of heat pumps is unbroken, with an overwhelming majority of air heat source types. According to Eurostat, the heat pumps put into operation in 2019 use 96% air heat in terms of performance. However, we also need to consider some of the disadvantages of the air heat source. Such a disadvantage is that the heat exchanger of the outdoor unit may freeze under certain weather conditions, in which case it is necessary to start a defrost cycle. This cycle reduces average performance and degrades the Coefficient of Performance (COP) of the system. The aim of my work is to eliminate the phenomenon by the fact that the heat pump does not only use the heat source of the air, but also obtains heat from the ground in critical weather conditions. Part of this research is the decision process presented in this publication, which was used to determine the location of the experimental equipment.

To start the decision-making process, we needed to build a database. The necessary data were generated based on our measurements and by collecting and analyzing the architectural data of various buildings. We also had to take into account the environmental conditions of each installation site, such as the type of terrain and the expected changes in air temperature.

Knowing the data and the parameters of the experimental equipment, we were able to select the determinants on the basis of which we constructed a decision flowchart. Very important aspects were the thermal insulation properties of the building, the temperature (and temperature spread) of the current or planned heating system, the free space available within the site for the installation of the soil collector and the existence of other heat generators in the building for the development of bivalent systems. Using our flowchart, we were able to rank the installation sites and then select the most appropriate one.

We had to perform additional tasks for the selected installation location. The way to connect to the heating system had to be worked out. The exact location of the site within the plot had to be determined. It was also necessary to determine the exact layout of the soil collector and the process of its formation. Proper planning of earthworks is an essential part of the installation, and careful planning can avoid unnecessary transport of the highlighted fold.

With the help of the presented decision process, it was possible to choose a suitable installation site for the experimental equipment. However, due to the length of construction work at the selected site, the equipment has not yet been installed and is expected to take place in the spring.

APPLICATION OF HYDROGEN PROPULSION IN INLAND NAVIGATION

E. Lévai, Á. Bereczky

Department of Energy Machines and Systems
Budapest University of Technology and Economics
Műegyetem rkp. 3. Budapest, 1111 Hungary
Tel.: +36 20 6170542, E-mail: levai.emesesarolta@edu.bme.hu

Nowadays alternative drives are a key segment of international research. The aim of the paper is to examine one of these, the hydrogen drive, from a technical point of view. In addition, the aim is to examine how the propulsion of a Hungarian lake ferry could be converted from an internal combustion engine propulsion to a hydrogen propulsion, in line with international trends, while maintaining its suitability for its current task. We also discuss the infrastructural transformation and investment required for inland hydrogen propulsion in inland lake transport and tangentially in other transport systems. The subject of the research is also to examine how the conversion affects the environment both directly and indirectly, especially by critically considering the energy demand of fuel production and the expected operating time in parallel.

The extreme importance of this topic is not only due to the fact that almost 90% of the world's freight is transported by the shipping industry (which is responsible for 8-10% of GHG emissions), but also due to the extremely interesting situation that the amount of information and knowledge about hydrogen-powered vessels, along which even a leap-like development can start, depending on geographical location. The aim of the paper is to present, through a case study and a general calculation, the aspects of the design and progress of a fuel cell ship, the values and losses to be taken into account, and the criteria for obtaining information from other industries. Respectively, what sizing method can be used for a specific application and through this will present the advantages and disadvantages of the technology.

In Hungarian inland shipping, freight and passenger transport tasks are currently performed by a fleet of equipment, the youngest representative of which has been operating continuously for 44 years. With the help of the calculations laid out in the research the investment model of the new powertrain can be evaluated and considered. We have developed a methodology that is suitable for installation without violating the old structure. Calculations for the hydrogen generation, storage and transport equipment suggest that the coastal infrastructure on Lake Balaton is suitable to accommodate one. Along with the research, we can also conclude that in the case of a transport task of this scale, power supply with batteries is a less good alternative compared to hydrogen fuel cell drive.

The subject of the research is also to examine how the conversion affects the environment both directly and indirectly, especially by looking critically at the energy demand of fuel production and the expected operating time in parallel.

Acknowledgements

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TIME SERIES MODEL FORECASTING OF ENERGY PRODUCTION 1 KWp SOLAR POWER PLANT

L. Lidyawati[1], M. Dawammudin[2], D. Rusirawan[2], I. Farkas[3]

[1]Department of Electrical Engineering, Institut Teknologi Nasional Bandung, Indonesia
[2]Department of Mechanical Engineering, Institut Teknologi Nasional Bandung, Indonesia
[3]Institute of Technology, Hungarian University of Agriculture and Life Sciences, Hungary
E-mail: lita@itenas.ac.id

Solar Power Plants (SPP) has recently been intensively echoed as one of the answers to the issue of climate change. SPP is a renewable energy that convert sunlight into electrical energy. SPP has environmental advantages, low maintenance costs and can increase the reliability of the electric power system. However, SPP has high investment costs and low efficiency. This efficiency is affected by solar radiation, temperature, and SPP conditions. Related to above issues, forecasting the energy production is needed to ensure the power continuity in order to store of the energy.

In this research, the forecasting of energy production is modelled using the Seasonal Autoregressive Integrated Moving Average (SARIMA) and Fuzzy Time Series (FTS) model. These models are a reliable technique in forecasting seasonal data. The performance of the model is evaluated by calculating mean absolute error (MAE) and root mean squared error (RMSE), as well.

As can be shown in Table 1, it is found that the SARIMA model has a lower MAE than the FTS model. The SARIMA model has an error of 0.069 while the FTS model 0.223. In the term of mean absolute percentage error (MAPE), the SARIMA model has an error of 2.1% while the FTS model 7.4%. Furthermore, based on the RMSE validation, it is found that the SARIMA model has an error value 0.091 and the FTS model 0.304. As a conclusion, it can be found that the SARIMA model has an accuracy of 97.9%, meanwhile the FTS model 92.6%, compared to the data reference.

Table 1. Comparison of Model Performance

Model	***MAE***	***MAPE***	***RMSE***
Persistence	0.836	26.4%	1.044
SARIMA	0.069	2.1%	0.091
FTS	0.223	7.4%	0.304

MODELLING THE FLUE CONDITIONS IN A SINGLE PASS SOLAR AIR COLLECTOR

Maytham H. Machi[1], J. Buzas[2], and I. Farkas[2]

[1]Doctoral school of Mechanical Engineering, [2]Institute of Technology
Hungarian University of Agriculture and Life Sciences
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 70 7435851, E-mail: cflo6k@uni-mate.hu

The interest in solar energy is growing, especially with the possible lack of oil and gas supplies, the increase in their prices, the problems of global warming, and the tendency to reduce dependence on fossil fuels. In addition, the global population is rising, which warns of a global food crisis that calls for search on real solutions. Therefore, solar air collectors are considered crucial devices in the solar energy field, and their apparent importance emerges in drying crops to reduce waste resulting from excess production that is damaged before reaching the final consumer.

The air-based collector's main problem is low thermal efficiency, which drew attention to optimizing their performance. There are different techniques used by the researchers regarding enhancing the overall collector efficiency such as, using extended surfaces, reducing the overall thermal losses, multi-pass flow. However, due to the properties of air, which are low thermal conductivity and heat capacity, it is still challenging to improve their performance compared to the liquid-based collector. The other complicated issue is controlling the flow process inside the collector and predicting the flow behaviour, especially when the collector has no baffles to guide the air along the channel. Thanks to the continuous progress in information technology and software engineering, it has become possible to use computing to predict the behaviour of any phenomenon or study and find solutions before the whole model is made, leading to saving in time and cost.

Computational fluid dynamics (CFD) software allows solar air collector optimization researchers to simulate their projects and understand how fluid flows, heat transfers, and heat distribution within the device. It converts many mathematical equations that describe the flow and heat transfer process to a more understandable and controllable graphical interface.

In the current work, the CFD ANSYS Fluent software was used for modelling and simulate the flow and heat transfer process of a single-pass solar air collector. The proposed collector has a flat absorber without any fins or baffles. The temperature distribution, velocity, and pressure contour have been computed. The results showed a good agreement with the results obtained from an experiment conducted by the Solar Laboratory at the Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary. From the results, we can conclude that introducing the baffles inside the air channel can play an essential role in enhancing the airflow, increasing the heat transfer by lengthening the air path and then increasing the air temperature.

Although all the modelling steps are applicable and controlled, at the same time, they must be treated with high accuracy, especially with the selection of the appropriate turbulence model and applying the initial conditions to obtain satisfactory results.

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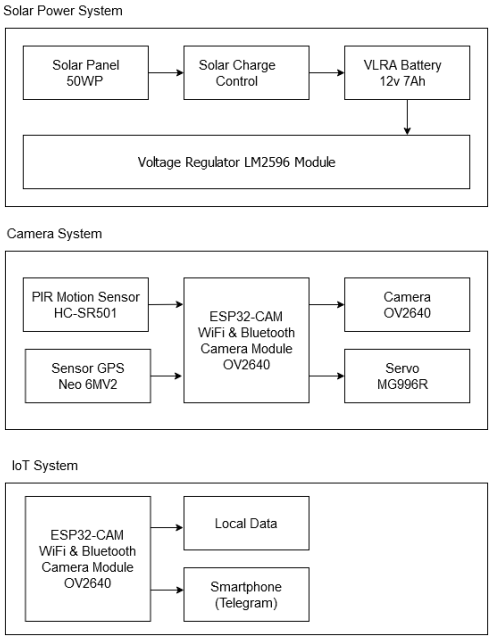
ANALYSIS OF DIGITAL IMAGE TRANSMITTING BASED ON INTERNET OF THINGS

N.K. Mahsa[1], L. Lidyawati[1], L, Kristiana[2], D. Rusirawan[3], I. Farkas[4]

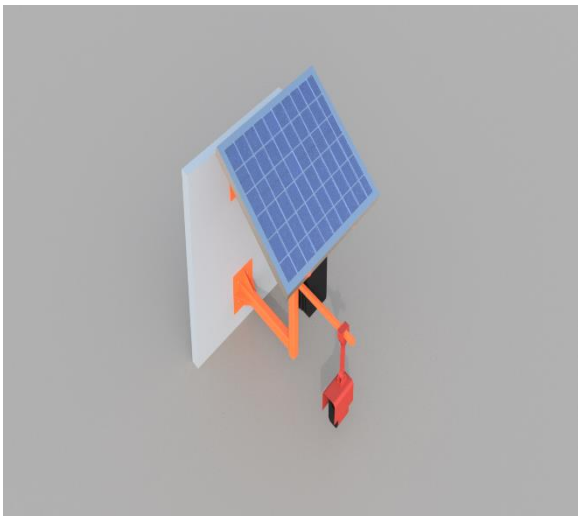
[1]Department of Electrical Engineering
[2]Department of Informatics
[3]Department of Mechanical Engineering
Institut Teknologi Nasional Bandung, West Java – Indonesia
[4]Institute of Technology, Hungarian University of Agriculture and Life Sciences, Hungary
E-mail: narishakalya@gmail.com

Security is always an issue both in individuals and communal attentions. Any forms of threats and crimes that occur in the village area of Karyawangi Parongpong, West Java, Indonesia, such as motor vehicle theft, violence, drug abuse, gambling, and others are caused by a lack of supervision from local authorities. The limitation of surveillance distance is one of the problems. Therefore, an effective and appropriate security system in a place is indispensable.

In this our community services, design and realizing the prototype of the security system using internet of things (IoT) modules and ESP32 Camera, will be presented for karyawangi Parongpong's village. The idea was proposed to create a motion sensor-activated surveillance camera security system based on AI Thinker CAM ESP 32. The camera will capture images based on the movement received by the Passive Infrared (PIR) (Passive Infrared) sensor and digital images from the camera will be sent to the smart phone via the telegram application. Photovoltaic is applied as the power supply of the system. These service activities were aimed at the improvement of security systems and increase knowledge of technology advances for rural communities in the Karyawangi Village environment, especially in security systems based on IoT. The block diagram and the prototype of the security system IoT based are presented in Fig. 1.



(a)



(b)

Fig. 1. (a) Block diagram of the system (b) The prototype of the system

PREDICTION OF BREAST CANCER USING MACHINE LEARNING

A. Maulidia[1], L. Lidyawati[1], L. Jambola[1], L. Kristiana[2]

[1]Department of Electrical Engineering
[2]Department of Informatics
Institut Teknologi Nasional Bandung, West Java – Indonesia
E-mail: annisamaulidia18@gmail.com

Algorithms in machine learning are a very important part, because the type of algorithm used has an impact on the level of prediction accuracy and classification of a data set that is owned. Appropriate use is accompanied by machine learning capabilities, namely being able to ideally study past patterns, making machine learning have an advantage in prediction accuracy which can reach 97%. Therefore, machine learning has the opportunity to be an alternative that can avoid diagnostic errors that occur in the case of breast cancer.

Breast cancer is one of the highlights of the impact of diagnostic errors because there are 10-30% of cases due to diagnostic errors, so it is needed an alternative that can help reduce these diagnostic errors. In this study, a comparative analysis of logistic regression algorithms, decision trees and gaussian naïve Bayes was carried out to obtain the algorithm with the best accuracy and performance values using the python programming language.

The evaluation method is very important to know the performance in the prediction process. By using three evaluation methods, namely cross-validation k=10, confusion matrix and ROC AUC. Based on this study, which is presented in Table 1, it was found that the algorithm with the best accuracy and performance was Logistic regression with an accuracy of 96.5% and an error of 0.19. While the accuracy of the decision tree is 91.2% has an error of 0.30 and the accuracy of Gaussian nave Bayes is 90.4% with an error value of 0.31.

Table 1. Performance comparison, error, and accuraccy

No	Algorithms	Accuration	Confusion Matrix		AUC	RMSE
			Precision	Recall		
1	Logistic Regression	0.965	0.957	0.956	0.963	0.19
2	Decission Tree	0.912	0.863	0.936	0.916	0.30
3	Gaussian Naïve Bayes	0.904	0.875	0.894	0.902	0.31

SYMMETRY ASPECTS OF THE OPTICAL SCATTERING PROCESSES IN SOLAR MATERIALS

Cs. Mészáros[1], I. R. Nikolényi[1] and Á. Bálint[2,3]

[1]Institute of Mathematics and Basic Sciences, Hungarian University of Agricultural and Life Sciences, Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel.: +36 28 522055, E-mail: Meszaros.Csaba@uni-mate.hu
[2]Institute of Environmental Engineering and Natural Sciences, Óbuda University
Doberdó str. 6, Budapest, H-1034 Hungary
[3]University Research and Innovation Center, Hydro-Bio-Mechanical Systems Research Center, Óbuda University, Bécsi str. 96/b, Budapest, H-1034 Hungary

It is well-known nowadays, that the experimental and theoretical investigations of basic structural properties of different types of carbon nanotubes play a role of continuously increasing importance in the contemporary condensed matter physics e.g. (Damnjanović and Milošević 2010). Among them, the research activities connected to possible applications in solar cells recently became also very significant. In the present study, we will demonstrate in detail some further possible and very promising applications of the group representation theory elaborated originally for complex molecular systems characterized by chain-type arrangements. The complete set of symmetry transformations belong to groups leaving invariant a *Q1D* system belongs to one of the infinitely many line groups uniquely gathered into 13 families. The basic algebraic symmetry- and representation theories of such types of discrete infinite chain systems have been elaborated in detail for decades, with many important applications including setting up the basic quantum-mechanical selection rules (Streitwolf, 1971) formulae, too.

In the present study, the advanced mathematical physics methods mentioned above will be applied in detail and incorporated into correlation functions necessary for comparing the experimentally determined-, and theoretically derived light scattering intensity curves. Although some of such-type applications of the irreducible representations of line groups in solid state physics are also known for decades, they are completely absent even from the most complete recent works about applications in various types of structural investigations of the incommensurately modulated condensed matter systems. In order to overcome these shortcomings, we apply here our own earlier results about generalized type description of structure factors (realized by a simple-, but completely novel-type use of the projective representations of line groups in the case of incommensurately modulated crystals) for extending the existing quantum mechanical formalism of selection rules developed for modelling the inelastic-type light scattering processes in such types of materials. Finally, the possible future applications of this formalism based on the newest methods (Dick, 2012) in the solar energetics will also be summarized.

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POWER QUALITY ANALYSIS AND POSSIBLE MITIAGTION APPROACHES FOR A GRID CONNECTED PHOTOVOLTAIC SYSTEMS

T. Negash[1], I. Seres[2] and I. Farkas[2]

[1]Doctoral School of Mechanical Engineering,[2]Institute of Mathematics and Basic Science
[3]Institute of Technology
Hungarian University of Agriculture and Life Sciences,
Páter K. u. 1., Gödöllő, H-2100 Hungary
Tel. +36 20 3685402, E-mail: Negash.Teklebrhan.Tuemzghi@phd.uni-mate.hu

Inspired by the rapidly evolving technical innovations and reduction in both manufacturing and operating costs the interest in Distributed Renewable Energy Resources (DRER) is growing significantly in recent decades. However, integration of DRER to the traditional power system is not without cost as it creates numerous technical challenges related to power quality. Power quality is the main concern in distributed renewable energy resources because modern devices (loads) are more sensitive to power disturbances. Maximizing the technical benefits of DRER is well-known challenge and is a hot topic of research by academia and utilities. Power operators (utilities) allow fixed amount of distributed renewable energy units, such as solar PV, to be integrated to the grid without violating any technical or legal constrains of the grid. At this penetration level the PV system can be seamlessly integrated to the grid without any adverse impact, and at this level no modification and protection is needed to the existing distribution network.

In future however, traditional power generation system is going to be dominated by distributed renewable energy generation units. Managing such a new scenario of power grid full of high-penetrated renewable generations will be complicated task and it will be necessary to perform deep research in several aspects since such scenarios will definitely exacerbate the existing power quality level if no advanced power quality improvement techniques are introduced. The impact of such high penetration scenario is not well addressed in previous studies. and this gives the gab for the current research. The general objective of this study is therefore, to analyse power quality issues related to high penetration level of grid connected photovoltaic technologies and to deal with their possible mitigation techniques.

In this study has the following main tasks are included:

a) A comprehensive analysis of power quality issues related to high PV penetration
b) To investigate the various power quality improvement techniques and to develop an optimal MATLAB/Simulink based mitigation model to enhance power quality
c) To determine pairwise correlation between weather parameters and module/inverter characteristic measurements such as temperature and DC/AC power output using exploratory data analysis methods

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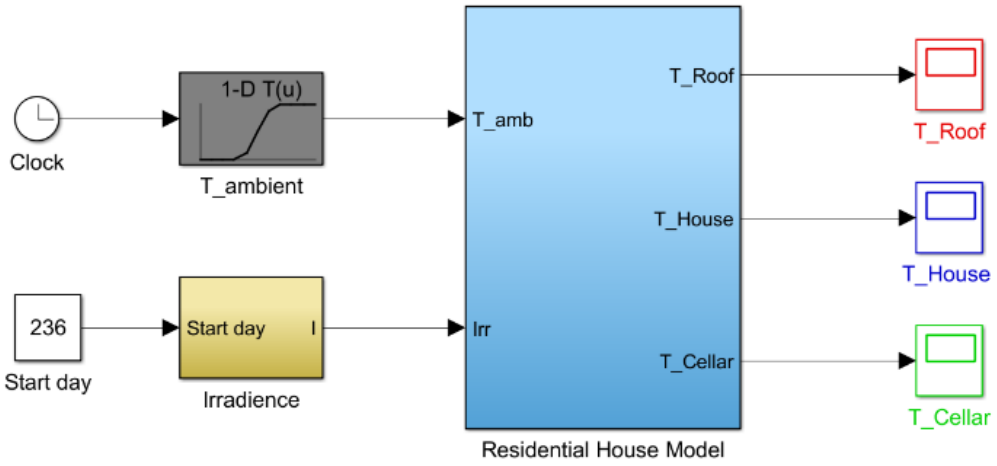
MODELLING OF BUILDINGS WITH A MATHEMATICAL APPROACH

Sz. Páger[1,2], A. Veres[1], L. Földi[1], and G. Géczi[1]

[1]Hungarian University of Agriculture and Life Sciences, Szent István Campus, Gödöllő, Hungary Tel.: +36 28 522-000, E-mail: veres.antal@uni-mate.hu, foldi.laszlo@uni-mate.hu; geczi.gabor@uni-mate.hu;
[2]Viega Kereskedelmi Kft. 1024 Budapest, Lövőház u. 30.
Tel: +36 70 8814970, E-mail: szabolcs.pager@gmail.com

Calculating heat losses and gains alone is not enough for a deeper energy study of buildings. The use of simulation is essential for modern procedures. Knowledge of physical processes is required to develop a proper model. It is advisable to use the already proven computer and simulation solutions in the thermal engineering modeling of buildings. This involves breaking down the processes into parts as a first step and then implementing mathematical models that describe the behavior of each part. In the case of a residential building, it is advisable to divide both the examined building and the elements in them. The building is divided into a living space, a basement (if any), and an attic based on practical considerations.



Matlab Simulink model of a building

The purpose of modeling is to provide comfort in the living space in all cases, in a way that minimizes energy consumption. In the model, it is possible to examine according to weather data, which includes the values of temperature, solar radiation, wind, and humidity. Unheated interiors adjacent to the living space also play a significant role in the temperature of the living space. Therefore, we also need to examine these to get a more accurate, more reliable model. Based on the structure of the model, the heat gains and heat losses of each space (living space, basement level, and attic space) are opposed to each other through the walls and windows. Energy is transported to the environment through external walls, roofs and floors, and doors in contact with the ground. The heat loss from filtration, the heat gain from solar radiation, and the internal heat load must also be taken into account when designing the model. Even the heat storage mass affects the behavior of the building.

EMPERICIAL CORRELATION OF OPTIMAL TURBINE INLET TEMPERATURE AND PRESSURE FOR GEOTHERMAL ORC

D. I. Permana[1,3], D. Rusirawan[3], I. Farkas[2]

[1]Doctoral School of Mechanical Engineering
[2]Institute of Technology
Hungarian University of Agriculture and Life Sciences, Páter K. u. 1., Gödöllő, 2100 Hungary
[3]Department of Mechanical Engineering,
Institut Teknologi Nasional, Jalan PHH. Mustofa no.3 Bandung, 40124 Indonesia
Tel. +36 70 7206738, E-mail: dicky91permana@itenas.ac.id

A developing geothermal utilization is one of many Hungarian government efforts to generate electricity and heating applications from renewable energy sector and to reduce fossil fuels usage due to the impact on the environment. Geothermal utilization for electricity generation has been implemented in Tura region and it is become the first geothermal plant in Hungary that producing electricity around 27 MW. The excess steam from Tura geothermal power-plant still has a potential energy that can converted to electricity and the objection in this study is implemented a heat recovery from excess steam through organic Rankine cycle (ORC).

ORC is similar as the SRC but uses low boiling temperature of organic fluids instead of water. Various advantages of ORC system are high efficiency, low turbine cost, compact size and the most important one is the environmental-friendly. The main disadvantage of the ORC system is that a separate precaution to prevent the leakage and contamination of organic fluid. Although, ORC can generate electricity in low range temperature, it still needs heat resource from another system, for instance from geothermal brine or excess steam. Tura Geothermal ORCs are classified as low temperature power-plant which has relatively low thermal efficiency. Therefore, it is necessary to design such systems on its optimum operating condition, for example, turbine inlet temperature and pressure (TITP) to optimize the energy recovery.

In this study, empirical correlations are acquired to calculate the optimal TITP of sub-ORC for geothermal applications, i.e. hybrid (flash-binary) power-plant and medium-enthalpy wells. In geothermal ORCs, injection temperature parameter is an important design imperative due restriction to mineral scaling. Thus, the ratio of excess steam temperature (or equivalently, the heat input) to critical temperature of the working fluids and the injection temperature, are used to correlate the optimal TITP. The prediction of the optimal TITP using the correlations is less than 5% error. These correlations are very advantageous for pre-design in fast and robust manner, especially to predict performance of new working fluids in specific working conditions. The correlations are derived from the optimal TITP data of 4 typical working fluids at maximum specific net-power resulted from GeSi (Geothermal Simulation). In order to evaluate the accuracy, the correlations are tested by using the simulation results of other 10 pure working fluids at excess steam temperature of 75-80 °C and injection temperature of 60-70 °C.

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COLLABORATION OF ITENAS BANDUNG AND VISEGRÁD FOUR'S INSTITUTIONS: INITIATION OF ESTABLISHING VISEGRÁD FOUR+ CONSORTIUM

D. Rusirawan[1], J. Horabik[2], Z. Hlavacova[3], M. Libra[4], I. Farkas[5]

[1]Institut Teknologi Nasional Bandung, Indonesia
[2]Institute of Agrophysics, Polish Academic of Sciences, Lublin, Poland
[3]Slovak University of Agriculture in Nitra, Slovakia
[4]Czech University of Life Sciences, Prague, Czech Republic
[5]Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary
E-mail: danir@itenas.ac.id

As one of Indonesia's higher educations, Institut Teknologi Nasional Bandung (ITENAS Bandung) has responsibility in strengthening the partnership, and hand in hand with other universities, both national or international, to collaborate in the fields of education, research, and university & society (community services), and support of the United Nation (UN) programme i.e., sustainable development goals (SDGs), especially in quality education point.

The intensive partnership between ITENAS Bandung and universities in European have been built since the 15th International Drying Symposium (IDS 2006) event, which is organized by Szent István University (as the predecessor of Hungarian University of Life Sciences/MATE), under chairmanship of Prof. Dr. Istvan Farkas. This partnership relations can be viewed as bridging for the ITENAS to interact with wider institution in European countries network, especially the countries with closely relation with MATE Hungary.

The involvement of the ITENAS Bandung in various scientific activities with the countries in Visegrad four (Hungary, Poland, Slovakia and Czech republic) has made ITENAS Bandung proposing an idea to establish the partnership consortium with the name Visegrad four+ (Visegrad four plus) consortium, with the members are Hungarian University of Life Sciences (MATE), Institute of Agrophysics – Polish Academic of Sciences (IA – PAS), Slovak University of Agricultural in Nitra (SUA), Czech University of Life Sciences Prague (CZU) and ITENAS Bandung. The concept Visegrad Four+ countries can be seen in Fig. 1.

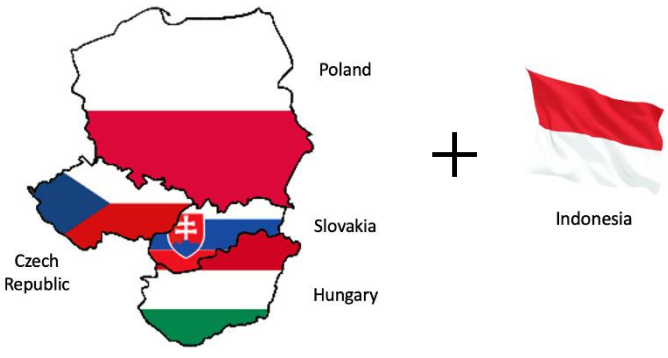

Fig. Involvement countries in consortium of Visegrad Four+

Actually, new policy in Indonesia about "freedom to learn (independent learning) – independent campus" is a challenge for ITENAS Bandung, and with establish of the Visegrad Four+ consortium, it is hope will enhance various collaboration and mobility, significantly, particularly in support excellent education, for a better world.

INFLUENCE OF TECHNICAL SNOWMAKING ON THE RADIATION BUDGET IN AN ALPINE AREA

P. Weihs, J. Laimighofer, M. Revesz, S. Schreier, H. Formayer

Department of Water, Atmosphere and Environment, Institute of Meteorology and Climatology,
University of Natural Resources and Life Science
Gregor-Mendel Straße 33, Wien, A-1180 Austria
Tel.: +43 1 47654 81424, E-mail: philipp.weihs@boku.ac.at

Technical snowmaking in ski areas is standard in Austria today to reduce dependence on natural snow and to ensure sufficiently long operating times for the ski areas. This adaptation measure leads to a longer, closed layer of snow on the surfaces of the ski slopes and thereby increases the reflection of sunlight - the albedo. Since this converts less solar energy into heat, it cools down locally. In a previous scientific study (Schwaiger et al., 2010, 2017), a simple radiation model was used to quantify the cooling effect by an increased albedo by the artificial snow and to compare it with the warming caused by the greenhouse gases released during the production of technical snow. The conclusion was drawn that total artificial snow leads to a cooling and thus counteracts anthropogenic climate change.

The aim of the present study is to repeat the same investigation with a more complex 3-d radiation model. Using a 3-d Monte Carlo model (Weihs et al.,2012) which includes the topography, a digital elevation map with 10x10m resolution and land use data simulations of the radiation budget and radiative forcing were performed for the Saalbach-Hinterglemm ski resort. In addition to the albedo effect of the inclined surfaces the 3-D model takes into account shading effects, the effect of trees along the slopes (canyon effect), as well as multiple reflections and the associated absorption effects on opposite slopes. On the one hand, the effect of snow-making on the radiation budget of the entire region was compared to the radiation budget during snow free conditions. On the other hand, the influence of snow making was simulated for average realistic scenarios with natural snow. The mean snow conditions of the past 30 years, based on the SNOWGRID data set from Austrian Weather Service ZAMG, were used for the months of November to April. The effect of technical snowmaking on the radiation balance of the entire area is -compared to simple radiation models - significantly reduced with complex 3-D modeling. The reduction of the absorbed solar radiation, taking into account the natural snow cover, is 2.3 W / m² in April, the month with the strongest cooling effect compared to values from other studies using simple radiation models of 14.7 W/m². This means that the cooling effect is overestimated by a factor of 6. Taking into account the trees along the ski slopes alone reduces the cooling effect by 16% and 46% depending on the month. It could be shown that simple radiation models are not suitable for estimating the area albedo in a mountainous area with snow cover in winter, since they lead to a drastic systematic overestimation.

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27th WORKSHOP ON ENERGY AND ENVIRONMENT

December 9-10, 2021, Gödöllő, Hungary

List of participants

Ajeena, Ahmed M.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Almadhhachi, Mensour
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Al-Rabeeah, A. Y.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Alshibil, Ahssan M.A.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Al-Yasiri, Q.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Bálint, Á.
Institute of Environmental Engineering and Natural Sciences,
Óbuda University,
Budapest, Hungary

Barótfi, I.
Institute of Technology
Hungarian University of Agriculture and Life Science
Gödöllő, Hungary

Bartha, S.
BIO-C-ECOIPAR LTD.
Gheorghe
Romania

Bereczky, Á.
Department of Energy Machines and Systems, Budapest University of Technology and Economics
Budapest, Hungary

Buzas, J.
Institute of Technology
Hungarian University of Agriculture and Life Science
Gödöllő, Hungary

Carvalheiro, F.
National Laboratory of Energy and Geology
LNEG, Departamento de Biotechnologia, Lisbon
Portugal

Csányi, Sz.
Renewable Energy Research Group
University of Pannonia
Nagykanizsa
Hungary

Daniarta, S.
Department of Thermodynamics and Renewable Energy Sources, Wrocław University of Science and Technology
Wroskaw, Poland

Dawammudin, M.
Department of Mechanical Engineering
Institut Teknologi Nasional Bandung (ITENAS)
West Java, Indonesia

Duarte, L. C.
National Laboratory of Energy and Geology, LNEG, Departamento de Biotechnologia, Lisbon
Portugal

Farkas, I.
Institute of Technology
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Fekti, L.R.
MVM Paks
Nuclear Power Plant Ltd.
Paks, Hungary

Földi, L.
Institute of Technology
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Formayer, H.
Institute of Meteorology and Climatology, University of Natural Resources and Life Science
Wien, Austria

Géczi, G.
Institute of Environmental Science,
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Géczy, G.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Habtay, G.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Halefom, K.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Hegedűsné Baranyai, N.
Renewable Energy Research Group
University of Pannonia
Nagykanizsa
Hungary

Hermanucz, P.
Institute of Technology, Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Hlavacova, Z.
Faculty of Engineering
Slovak University of Agriculture in Nitra
Nitra
Slovakia

Horabik, J.
Institute of Agrophysics
Polish Academic of Sciences
Lublin
Poland

Imre, A.R.
Department of Energy Engineering,
Budapest University of Technology and Economics
Budapest, Hungary

Jambola, L.
Department of Electrical Engineering,
Institut Teknologi Nasional (ITENAS) Bandung
West Java - Indonesia

Kátai, L.
Institute of Technology
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Kolasinski, P.
Department of Thermohydraulics
Centre for Energy Research
Budapest
Hungary

Kristiana, L.
Department of Informatics
Institut Teknologi Nasional (ITENAS) Bandung,
West Java – Indonesia

Laimighofer, J.
Institute of Meteorology and Climatology, University of Natural Resources and Life Science
Wien, Austria

Lévai, E.
Department of Energy Machines and Systems, Budapest University of Technology and Economics
Budapest, Hungary

Libra, M.
Czech University of Life Sciences
Prague,
Czech Republic

Lidyawati, L.
Department of Electrical Engineering,
Institut Teknologi Nasional Bandung
West Java, Indonesia

Machi, Maytham H.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Mahsa, N.K.
Department of Electrical Engineering
Institut Teknologi Nasional Bandung,
West Java – Indonesia

Maulidia, A.
Department of Electrical Engineering,
Institut Teknologi Nasional (ITENAS)
Bandung, West Java - Indonesia

Mészáros, Cs.
Department of Physics
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Moniz, P.
National Laboratory of Energy and Geology
LNEG, Departamento de Biotechnologia, Lisbon
Portugal

Negash, T.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Nikolényi, I. R.
Department of Physics
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Patonai, Z.
Institute for Environmental Engineering System, Szent István University
Gödöllő, Hungary

Páger, Sz.
Hungarian University of Agriculture and Life Sciences, Szent István Campus
Gödöllő, Hungary

Permana, D.I.
Mechanical Engineering Doctoral School
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Pintér, G.
Renewable Energy Research Group
University of Pannonia
Nagykanizsa, Hungary

Revesz, M.
Institute of Meteorology and Climatology, University of Natural Resources and Life Science, Wien, Austria

Rusirawan, D.
Department of Mechanical Engineering
Institut Teknologi Nasional (ITENAS)
Bandung,
West Java - Indonesia

Schreier, S.
Institute of Meteorology and Climatology, University of Natural Resources and Life Science
Wien, Austria

Seres, I.
Department of Physics
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Szabó, I.
Institute of Technology
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Szabó, M.
Institute of Technology
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Székely, L.
Institute of Mathematics and Basic Science
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Veres, A.
Institute of Mathematics and Basic Science
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Víg, P.
Department of Physics
Hungarian University of Agriculture and Life Sciences
Gödöllő, Hungary

Vincze, A.
Renewable Energy Research Group
University of Pannonia
Nagykanizsa
Hungary

Weihs, P.
Institute of Meteorology and Climatology, University of Natural Resources and Life Science
Wien, Austria

Zsiborács, H.
Renewable Energy Research Group
University of Pannonia
Nagykanizsa, Hungary


MATE
HUNGARIAN UNIVERSITY OF
AGRICULTURE AND LIFE SCIENCES