ISSTIN 2012

PROCEEDING

INTERNATIONAL SEMINAR ON SCIENCE AND TECHNOLOGY INNOVATIONS 2012

Green Technology Innovations for A Sustainable Society

University of Al Azhar Indonesia
2-4 October 2012

Organized by:
Faculty of Science and Technology
University of Al Azhar Indonesia

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Universitas Al Azhar Indonesia

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Seminar on Science Technology and Innovation 2012

Prof. Dr. Ir. Zuhal, M.Sc.E.E.
Rector
University of Al Azhar Indonesia

Assalaamu'alaikum warahmatullahi wabarakatuh,

Distinguished guest,

All praises and glory to Allah Subhanahu wa Ta'ala, The Almighty, for allowing us to gather for this distinguished Forum at the University of Al Azhar Indonesia. First of all I would like to express my deep satisfaction to the committee for their efforts to make this program happen, also to the Islamic Development Bank for their support and other sponsors as well.

This International Seminar is organized by the Faculty of Science and Technology. In essence, this Seminar is a manifestation of concerns by the faculty members on the continuing destructions of our environment, and an expression of this faculty to promote the use of green technology in the society. It is hoped that this seminar could help promoting green lifestyle through the use of green technology in this country, and to raise public awareness on the need to be innovative and to produce climate smart processes and products.

I wish all of you the best of luck and much courage as you presenting and be presented in this international seminar with new ways of creating a world that works for everyone with no one left out, and of acquiring mutual knowledge that enable us to build a better future - a sustainable society.
Thank you very much.

Wassalaamu'alaikum wa Rahmatullahi wa Barakatuh

Dr. Ary Syahriar, DIC
Dean of Faculty of Science and Technology
University of Al Azhar Indonesia

Assalaamu'alaikum warahmatullahi wabarakatuh,

Welcome to the 1st International Seminar on Science and Technology Innovation 2012 (ISSTIN 2012). Additionally, the aim of ISSTIN 2012 is to facilitate the communication of academic between domestic and foreign, to construct international platform and also to exhibit the new fruits on science and technology innovation.

We are honored to have the State Minister of Research and Technology Republic of Indonesia to convey his keynote speech. Apart of it, we will also have plenary sessions with six speakers in the first and second day with various backgrounds to share about state of the art of green technology innovation such as green technology, green computing, green building, etc.

ISSTIN 2012 is supported primarily by The International Development Bank (IDB) Jeddah, and also PT Pembangunan Jaya Ancol, PT Agung Podomoro Land, PT Solusi247 and our media partners Republika and JakTV.

Finally, it is both our duty and pleasure to express our gratitude for the work done by the referees as well as the hardworking team to make this seminar successful. Without their efforts many of the papers in this volume would not have been improved.

We hope and believe that everybody will have an academic enjoyment during this seminar and pleasant stay in Jakarta.

Wassalaamu'alaikum wa Rahmatullahi wa Barakatuh

Nunung Nurhasanah, ST., MSi.
Chairperson
Organizing Committee of ISSTIN 2012

Assalaamu'alaikum warahmatullahi wabarakatuh,

Dear Colleagues,

On behalf of the Organizing Committee, I am honored to welcome you to the International Seminar on Science and Technology Innovations 2012 (ISSTIN2012). This seminar is organized by the Faculty of Science and Technology, University of Al Azhar Indonesia (UAI), Jakarta.

This year we received 77 paper submissions from various universities, research centers, and its affiliations. The Technical Program Committee accepted 70 selected papers that will be presented in this seminar. The accepted papers are categorized into four groups; Biotechnology, Electrical Engineering, Industrial Engineering, and Information Technology.

And finally, the success of this seminar is due to the hard efforts of many people who we gratefully acknowledge. We also thank the authors whose papers are presented, invited keynote speakers, and all parties that we are not able to mention here.

We hope you all will enjoy the two days of discussion through this seminar and enjoy the beauty of Jakarta and the UAI campus. We hope to see you again next year, in the Seminar on Science and Technology Innovations 2013.

Wassalaamu'alaikum wa Rahmatullahi wa Barakatuh

Proceeding of Seminar on Science and Technology Innovation 2012

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(Information Technology, University Indonesia)

KEY NOTE SPEAKER

Prof.Dr.Ir.H. Gusti Muhammad Hatta, MSc (State Minister of Research and Technology Republic of Indonesia).

Graduated from UNLAM, Banjarmasin, Faculty of Forestry, affiliated with Institut Pertanian Bogor. Master degree from Universitas Gadjah Mada, and doctoral degree from Wageningen University, The Netherlands.

Experience, among others:

- 2003-2005 – Head of Research Department UNLAM, Banjarmasin.
- 2006-2009 – Vice Rector, UNLAM, Banjarmasin.
- 2009-2011 – Minister of Environment.
- 2011-present – State Minister of Research and Technology, Kabinet Indonesia Bersatu II.

Speaker I of Plenary Session

Datuk Dr. Tengku Mohd. Azman Shariffadeen (IDB Consultant, Malaysia)

He served as an academic at the Faculty of Engineering, University of Malaya, for eleven years and spent the next 21 years as the founding Director General and CEO of the Malaysian Institute of Microelectronic Systems (MIMOS). He served for nine years as the ex-officio secretary of the National Information Technology Council, chaired by the Prime Minister of Malaysia. In this capacity he was closely involved with the formulation and implementation of national ICT policies and strategies, in particular, the Multimedia Super Corridor (MSC) and the National IT Agenda (NITA).

Currently shares his experience in knowledge and innovation for development, particularly in projects in the Middle-East and the Asia Pacific Region. He is a Fellow, Academy of Sciences, Malaysia; Member, National Science and Research Council, Malaysia; Adjunct Professor, International Islamic University, Malaysia; Member, High-Level Advisory Panel, Global Alliance for ICT and Development, United Nations; Advisor, Al Aghar Group, Kingdom of Saudi Arabia and Member, New Club of Paris. He is a director of Pernec Corporation Berhad, an IT company.

Abstract:

INNOVATING FOR
A GREENER FUTURE THROUGH SCIENCE AND TECHNOLOGY –
FRAMEWORKS FOR EFFECTIVE ANALYSIS, PLANNING AND MANAGEMENT

This presentation introduces several frameworks which enable effective analysis, planning and management of innovation that is based on science and technology. A value chain of the innovation process flow reveals a major difference between a producer nation and a consumer nation. While a producer is able to implement a seamless flow from science and technology development to its eventual application to realise value, the consumer suffers an "innovation chasm" that separates the production of knowledge from the production of goods or services.This chasm has to be bridged if consumer nations are to become producers. The collaboration of key actors in the public sector, private sector and the community sector is crucial. In particular the role of entrepreneurs in the incubation of technologies and businesses that arise from them is prominent. The value chain analysis provides an effective description of the components of a national innovation eco-system and how they are linked.

A core bridging function is the process of diffusion and adoption of innovations, which is explained using Rogers' model. From this analysis it becomes clear that the act of inventing is insufficient to innovate. Diffusion and adoption involves acceptance and actual use of inventions by potential users and consumers. This often overlooked fact is a major challenge, with almost total emphasis normally given to the creation and invention phases of innovation.

The World Economic Forum's Growth Competitiveness Index is another framework that facilitates analysis and planning. Examples are provided of country ranking that reveal key areas of policy and strategy intervention that may help to accelerate innovation-driven competitiveness.

Finally the 7i framework (Nair 2007) to measure innovation capacity and rank countries is introduced. By way of examples it is demonstrated how the framework may be applied to identify areas of improvement so that a country may be able to plan and undergo rapid increase in innovation capacity.

Speaker II of Plenary Session

Ir. Rana Yusuf Nasir (Director Rating & Technology of Green Building Council Indonesia, President Director of PT Airkon Pratama, Indonesia)

Graduated from Institut Teknologi Bandung, on Applied Physics. Expert in Building Engineering Services & HVAC System.

Affiliations:

- Member of U.S. Green Building Council - New York Chapter
- Core Founder Green Building Council Indonesia
- Director of Rating & Technology GBCI and responsible for developing Greenship Rating System Tools
- President 2009-2010 - ASHRAE: American Society for Heating, Refrigeration & Airconditioning Engineer: Indonesia Chapter
- Member of IAFBI (Ikatan Ahli Fisika Bangunan Indonesia)
- Member of Technical Team - Komite Nasional Perlindungan Lapisan Ozon
- AC Working Group Leader for HCFC Phase-out Management Plan for Ministry Office of Environment

Experience/Achievements:

- Specializing on Operation & Maintenance for Building Utilities and M&E Contracting
- Supplying HVAC Central System, Install & Maintenance
- Energy Saving & Upgrading Performance of Building Utility
- Supporting Ozone Layer Protection activity for Ministry Office of Environment since 1992
- Receiving 2 (two) Awards for Active Role in Environment Program from Ministry of Environment: Year of 1998 and 2008.

Abstract:

GLOBAL TREND FOR BUILDING :
GREEN AND HIGH PERFORMANCE BUILDING

As global population significant growth for the last century reaching about more 7 billion people, makes a significant growth also an increasing number of building for live space, for working and for other activity.

The building industry sector have contributed up to 17% in water use from the use of water consumption worldwide, 35% use wood from forests, 40% of energy use, and it contributed 33% of CO2 emissions which is one of the biggest contribution of greenhouse gas. Building sector also consumed one third of earth natural resources. In other words, the building industry gives impact to and contribute to environmental damage, the symptoms of global warming and climate change.

Buildings have a surprisingly profound impact on our natural environment, economy, health, and productivity. Building should be designed for not spoiling the environment, better indoor quality to reduce health risk, comfortable space to increase working spirit to boost the productivity and in from economy aspect, has a better life cycle cost. From this perspective, green building concept and as well as high performance building concept was created.

For evaluation and assessment a building to be certified as Green Building, it needs a rating tools which had been developed by Green Building Council Indonesia. In developing rating tools, Green Building Council Indonesia (GBCI) set a corridor for the tools as :

a. Simplicity and not a complex one.
b. Applicable
c. The availability of product and technology.
d. The required additional investment as low as possible.

Recently, GBCI already launched 2 (two) rating tools : Greenship Rating Tools NB (New Building) version 1.1 and Greenshiip Rating Tools EB (Existing Building) version 1.0. Until end of 2012, there are 77 building have sent their intention to apply for certification, 25 project already registered and in the process of certification, the other is still in registration process. 54% of the numbers are for New Building Certification, 73% oh the numbers located in DKI Jakarta, and the others are in West Jawa, Central Jawa, and Bali.GBCI has awarded a Certification based on Greenship Rating Tools for 3 (two) building : Kantor Pusat Management PT Dahana, Subang for New Building Criteria, Menara BCA, Jakarta for Existing Building, both achieved Platinum Level. The third is Sampoerna Strategic Building for Existing Building and achieved Gold Level.

For new building, there is a one step before completed assessment that if the building owners aimed to evaluate their building on design stage, and GBCI will do assessment based on tender drawing and the result called as “Design Recognition. For this stage, GBCI has awarded a “Design Recognition” to :

- Gedung Utama Kementerian Pekerjaan Umum, Jakarta expected to achieve a Platinum Level.
- Institut Teknik & Science Bandung, Cikarang expected to Gold Level
- Rasuna Tower, Jakarta expected to Gold Level.
- Bank Indonesia Solo expected for Platinum Level

Speaker III of Plenary Session

Ir. Budi Karya Sumadi (President Director of PT. Pembangunan Jaya Ancol, Indonesia).

Graduated from Universitas Gajah Mada, Yogyakarta, Department of Architecture.

Job Experience

2001 – 2004 Finance Director, PT Pembangunan Jaya Ancol Tbk.
2001 – 2004 Finance Director, PT Taman Impian Jaya Ancol
2001 – now Commissioner, PT Philindo
2004 – now President Director, PT Pembangunan Jaya Ancol Tbk
2004 – now President Director, PT Taman Impian Jaya Ancol

Organizations

2003 – now Chairman Assistant, Independent Golf Club Indonesia
2005 – now Head of Education & Training Department, Indonesian Public Listed Companies Association
2005 – now Board of management, KONI DKI Jakarta
2005 – now Chairman, Jaya Raya Utama Foundation

Abstract:

MANAGING DREAMS

The Ancol amusement park, is one of the most visited destination in Asia. Recently Ancol tries to contribute the best for the environment by introducing the Ocean Ecopark. The area is reinvented on three concepts; of green, for open area utilization; blue, for water management; and red for the activities. The locale is developed with four area of themes: Eco Energy, Eco Care, Eco Nature and Eco Art. Ancol promotes initiatives in education and green living style to be a green company applying environment friendly corporate culture.

Speaker IV of Plenary Session

Ir. Jusman Syafii Djamal (Chairman of Matsushita Gobel Foundation, Indonesia).

Graduated from Institut Teknologi Bandung, Mechanical Engineering.

Experience, among others:

- 2000-2003 – President Director of PT Dirgantara Indonesia.
- 2005-present – Chairman of Matsushita Gobel Foundation.
- 2007-2009 – Minister of Transportation, Kabinet Indonesia Bersatu I.
- 2011-present – Member of Komite Inovasi Nasional, lead by Prof. Dr. Ir. Muhammad Zuhal, M.Sc.EE.

Abstract:

FOR FUTURE GENERATIONS, PANASONIC AIMS TO BECOME
THE NO. 1 GREEN INNOVATION COMPANY
IN THE ELECTRONICS INDUSTRY

Panasonic was founded based on the philosophy of contributing to progress in society and to enriching people's lives through business activities. By offering products that help people lead better, greener lives, Panasonic has made close ties with people worldwide.

Panasonic believes that they can integrate contribution to the environment with business growth, by driving green innovation in all aspects of our business practices such as product development firmly rooted in people's everyday lives and production activities.

The 'eco ideas' mark symbolizes Panasonic's strong commitment to continuous environmental sustainability management.

Speaker V of Plenary Session

Prof.Dr. Rosnah Mohd.Yusuff (Department of Mechanical and Manufacturing Engineering, Universiti Putra Malaysia, Serdang, Malaysia).

Graduated Bachelor degree on Chemistry, Master degree on Industrial Engineering and Management from University of Iowa, USA, and Doctoral degree on Manufacturing System from Universiti Putra Malaysia (UPM), Malaysia.

Professional Qualification/Membership/Affiliation:

- Past Secretary, Engineering Education and Training Committee (EETC) of the Federation of Engineering
- Institutions in Islamic Countries, FEIIC
- Past Secretary, EETC news bulletin, ENTIC, FEIIC
- Member, Editorial board of Inderscience publishers
- Executive Council Member, of Pan Pacific Council on Occupational Ergonomics
- Member, International Ergonomics Association Technical Committee Member on Primary Industries
- Member, International Ergonomics Association Technical Committee Member on Musculoskeletal Disorders
- Protem Committee Member, Human Factors and Ergonomics Society of Malaysia
- Founding Member, Malaysian Society of Engineers and Technologists
- Member, Executive Board Member and IEM-FEIIC National Monitoring Committee (2007-2009)
- Member, FEIIC- Kuala Lumpur Regional Office (2007-2009)
- Member, EQAPS-FEIIC (2007-2009)
- Chief Editor, FEIIC Bulletin and Publication (2007-2009)
- Member, Standing Committee on Innovation Foresight (FEIIC, 2007-2009)

Abstract:

ENVIRONMENTAL CONSCIOUS MANUFACTURING
FOR SUSTAINABLE GROWTH

Companies must be more environmentally conscious, focus on sustainable practices and materials, and become more socially responsible corporations. Current manufacturing activities have caused the degradation of the environment, the depletion of resources at an accelerated rate, global warming, and affected the quality of life. New technologies, the short life cycle of products consumed more resources that hinder sustainable growth. Thus, companies have to transform their manufacturing activities, not only to increase competitiveness but to consider the impact of their activities on the environment in a socially responsible manner. Environmental conscious manufacturing when practiced addressed the environmental necessity and provide the means of managing the depletion of resources. Enhancing the understanding of the practices of ECM and their impacts on the environment will enable companies to develop their manufacturing strategies.

Keywords - Environmental conscious manufacturing (ECM), Reverse logistics, 6Rs, sustainable growth

Speaker VI of Plenary Session

Dr. Ade Jamal (Head of Department of Informatics Engineering).

PhD degree from Delft University of Technology, The Netherlands. He serves as a researcher in Badan Pengkajian dan Penerapan Teknologi (BPPT) and Head of Korea-Indonesia ICT Training Center, Ministry of Communication and Information in 2010-2011.

Abstract:

GREEN COMPUTING,
JUST ANOTHER BUZZWORD OR REALLY CAN MAKE WORLD CLEANER?

Nowadays, green computing is attracting more attention from IT people whether they are designers, manufacturers, organization or even just end-users of information technology who have environmental awareness. However, just like most of environmental issues in other fields, many people still consider green computing as just a “nice to have” technology or justanother buzzword from the environmental activist.

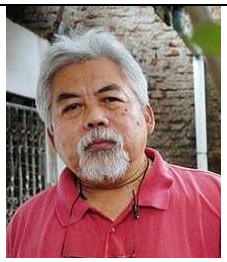
By definition green computing is the study and practice of designing, manufacturing, using and disposing of computers, servers and associated subsystems efficiently and effectively with minimal or no impact on the environment. In the early ninety, environmental awareness was started by Energy Star Label which is a seal approval from regulator to reduce energy consumption by using energy efficient hardware. This Energy Star Label disappeared when the power efficient LCD monitors came into the market replacing the CRT monitor. This is one example of successful green computing movement from computer designer and manufacturer to enhance better environment.
Reducing energy is always the first priority but using energy efficient product is not the only approach in the green computing. This paper will present various issues in the green computing from practical issue to the state of the art technology such as virtualization and cloud technology.

Keywords: green computing, energy saving, Cloud Technology

List of Invited Speakers

Prof. Dr. Saiyed I. Ahmed
HEC Foreign Professor and
Coordinator, Dengue Research Program
Institute of Microbiology,
University of Agriculture, Faisalabad

Prof.Dr. Johan Iskandar
Professor of Etnobiology Biological Department University Padjajaran
Institute of Ecology, University Padjajaran, Bandung, Indonesia



Dr. Anjum Suhail
Chairman of Dept. of Agri. Entomology, University of Agriculture, Faisalabad-Pakistan

Dr. Lisman Suryanegara, M.Agr
Researcher at Indonesian Institute of Science, LIPI
Centre of Biomaterial

Associate Professor Alyani Ismail
Centre of Excellence for Wireless and Photonic Networks
Department of Computer and Communication Systems Engineering Faculty of Engineering, Universiti Putra Malaysia,

Assoc. Prof. Dr. Raja Syamsul Azmir B Raja Abdullah
Department of Computer & Communication Systems
Engineering,
Universiti Putra Malaysia

Rini Akmeliawati, PhD
Chairperson of Intelligent Mechatronics System Research Unit (IMSRU-IIUM)
International Islamic University Malaysia

Assoc. Prof. Dr. Chuvej Chansa-ngavej
Director, Shinawatra University Research Center
Shinawatra University, Thailand

Dana Sulistiyo Kusumo
School of Computer and Engineering
UNSW, New South Wales, Australia

Moch. Arif Bijaksana
Research member of e-Discovery Lab
School of Electrical Engineering and Computer Science
Faculty of Science and Engineering, Queensland University of Technology (QUT)
Brisbane, Australia

Lecturer at Institut Teknologi Telkom, Bandung.

EVENT SCHEDULE
INTERNATIONAL SEMINAR ON SCIENCE AND TECHNOLOGY INNOVATION 2012 (ISSTIN2012)
UNIVERSITY AL AZHAR INDONESIA, JAKARTA, 2-4 OCTOBER 2012

DAY 1

TIME	TUESDAY, OCTOBER 2nd, 2012		
08.00-08.30	Registration		
08.30-09.00	Opening Exhibition		
09.00-10.15	Opening		
	Key Note Speech by Prof.Dr.Ir.H. Gusti Muhammad Hatta, MSc State Minister of Research and Technology		
10.15-10.35	Coffee Break		
10.35-12.15	Plenary Seminar		
	Moderator: Dr. YS Hidayat		
	1. Datuk Dr. Tengku Azman Sharifadeen (IDB Consultant)		
	2. Rana Yusuf Nasir (Director for Rating & Technology, Green Building Council Indonesia)		
	3. Budi Karya Sumadi (President Director of PT. Pembangunan Jaya Ancol)		
	4. Jusman Syafii Djamal (Chairman of Matsushita Gobel Foundation)		
12.15-13.30	Lunch Break		
13.30-15.00	Parallel Seminar 1		
	Decision Analysis R. 317 A Moderator: Syarif Hidayat	Eco Devices R. 317 C Moderator: Suci Rahmatia	Ecology R. 317 C Moderator: Nita Noriko
	1. Invited Speaker Assoc. Prof. Dr. Chuvej Chansangavej	1. Invited Speaker Assoc. Prof. Dr. Alyani Ismail	1. Invited Speaker Prof. Dr. Johan Iskandar
	2. IE-02	2. Invited Speaker Dr. Lisman Suryanegara	2. Invited Speaker Dr. Anjum Suhail
	3. IE-06	3. EE-07	3. BIO-07
	4. IE-12	4. EE-23	4. BIO-09
15.00-15.20	Coffee Break		
15.20-16.50	Parallel Seminar 2		
	Software Engineering R. 317 A Moderator: Winangsari P	Biodiversity R. 317 B Moderator: Vanny Narita	Bio & Eco Instrumentation R. 317 C Moderator: Yaya Suryana
	1. Invited Speaker Dana Kusumo	1. Invited Speaker Prof. Dr. Saiyed Ahmed	1. Invited Speaker Rini Akmeliawati, PhD
	2. IF-08	2. BIO-01	2. EE-01
	3. IF-09	3. BIO-05	3. EE-02
	4. IF-14	4. BIO-14	4. EE-08
16.50-19.00	Free		
19.00-21.00	Honorary Dinner		

DAY 2

TIME	WEDNESDAY, OCTOBER 3rd, 2012		
09.00-10.30	Parallel Seminar 3		
	Image Processing & Intelligent Systems R. 317 A Moderator: Nida'ul H	Good Manufacturing Process R. 317 B Moderator: Niken Parwati	Communication Development R. 317 C Moderator: Octarina NS
	1. Invited Speaker Moh. Arif Bijaksana	1. IE-03	1. Invited Speaker Assoc.Prof.Dr. Raja Syamsul Azmir B Raja Abdullah
	2. IF-01	2. IE-10	2. EE-03
	3. IF-06	3. IE-14	3. EE-05
	4. IF-15	4. IE-16	4. EE-14
		5. IE-17	5. EE-15
10.30-10.45	Coffee Break		
10.45-12.00	Plenary Seminar 2 317a + 317b		
	Moderator: Dr. Syarif Hidayat		
	1. Prof.Dr.Rosnah Mohd.Yusuff (UPM)		
	2. Dr. Ade Jamal (UAI)		
12.00-13.30	Lunch Break		
13.30-15.00	Parallel Seminar 4		
	Microbiology R. 317 A Moderator: Riris Lindawati	IT Utilization R. 317 B Moderator: Endang Ripmiatin	Supply Chain & Product Development R. 317 C Moderator: Ahmad Juang
	1. BIO-02	1. IF-02	1. IE-08
	2. BIO-03	2. IF-03	2. IE-09
	3. BIO-08	3. IF-05	3. IE-11
	4. BIO-10	4. IF-13	4. IE-13
			5. IE-18
15.00-15.20	Coffee Break		
15.20-16.50	Parallel Seminar 5		
	Optical Communication R. 317 A Moderator: Octarina NS	Biotechnology R. 317 B Moderator: Riris Lindawati	Mobile Application and DBMS R. 317 C Moderator: Ade Jamal
	1. EE-11	1. BIO-06	1. IF-04
	2. EE-13	2. BIO-11	2. IF-10
	3. EE-17	3. BIO-12	3. IF-11
	4. EE-18	4. BIO-16	4. IF-16
	5. EE-19		

DAY 3

TIME	THURSDAY, OCTOBER 4th, 2012
08.30-12.00	Old Jakarta Tour

TABLE OF CONTENTS

Industrial Engineering

TUNING OPTICAL FIBER RING RESONATOR FILTER

Alfazil[1], Sasono Rahardjo[2], Ary Syahriar[1,3]

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University of Al Azhar Indonesia, Jl. Sisingamangaraja, Jakarta 12110
[2]Pusat Penelitian Ilmu Pengetahuan & Teknologi
[3]Komite Inovasi Nasional

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Abstract - **Filter is one of the important component in an optical communication system in the future, a structure that can be aplicated for the wavelenght filter in optical communication is ring resonator. This paper aims to design a tunable filter base on optical fiber ring resonator (OFRR). The theoretical results show that by changing the lenght of L (circumference of the ring) can affects on output of the FORR filter. The expected results of this paper are that the output of the FORR filter is based on dense wavelenght division multiplexing (DWDM) ITU grid specification.**

Keywords **-** Optical Fiber Ring Resonator, Optical Filter, DWDM

I. INTRODUCTION

With better understanding and recent advances in fabrication techniques, optical fiber ring resonator (OFRR) have been successfully used as sensor, biosensor [1], optical bistability [2], laser resonators [3], fiber dispersion compensation, optical switching, add/drop multiplexer, optical filters [3,4], etc.

OFRR's structure basically consists of a 2 x 2 port directional coupler and fiber loop connecting one of the input ports to one of the output ports. The characteristic response of an OFRR is determined by several parameters such as the length of the resonator loop and delay time, coupler coupling coefficient, finesse [4], and various others parameters [1].

In this paper, we proposed a tunable optical fiber ring resonator (OFRR) filter based on dense wavelenght division multiplexing (DWDM) ITU grid spesification.

II. THEORY OF RING RESONATOR

A schematic diagram of a single optical fiber ring resonator with one coupler is shown in figure 1. For zero coupling, $\kappa = 0$, and for 100% coupling, $\kappa = 1$. If the directional coupler has a large coupling, light introduced to the input port 1 will couple mostly to the output port 4. Meanwhile, the trapped light in the fiber ring will couple from port 2 to port 3 and will continue circulate.

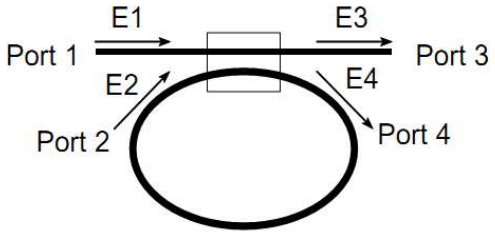


Figure 1. A schematic diagram of a single OFRR with one coupler

The directional coupler is modeled as a lossless device, and refer to fig. 1, the fractional intensity loss (γ) of directional coupler is 0.05 ~ 0.1 in general. The formula is given by :

$$|E_3|^2 + |E_4|^2 = (1 - \gamma)\,(|E_1|^2 + |E_2|^2) \quad \ldots. (1)$$

where E_i is the complex field amplitude at the ith port.

Considering the circulation in fiber ring and the coupled-mode interaction in directional coupler, the complex amplitude relation is given by :

$$E_3 = \sqrt{1-\gamma}\left[\sqrt{1-\kappa}E_1 + i\sqrt{\kappa}E_2\right] \ldots (2)$$

$$E_4 = \sqrt{1-\gamma}\left[i\sqrt{\kappa}E_1 + \sqrt{1-\kappa}E_2\right] \ldots (3)$$

$$E_2 = E_4\,\alpha \cdot e^{j\theta} \qquad \ldots (4)$$

where κ is the intensity of coupling coefficient, given by :

$$\kappa := \left(\frac{\lambda}{2\cdot\pi\cdot n1}\right)\cdot\left(\frac{U^2}{a^2\cdot V^2}\right)\cdot\frac{K0\left(W\cdot\frac{d}{r}\right)}{K1(W)\cdot K1(W)} \ldots (5)$$

α is the loss coefficient of the ring (zero loss: $\alpha = 1$) and $\theta = \omega L/c$, L being the circumference of the ring which is given by L = 2πr, r being the radius of the ring measured from the center of the ring to the center of the fiber, c the phase velocity of the ring mode ($c = c_0 / n_{eff}$) and $\omega = kc_0$, c_0 refers to the vacuum speed of light. The vacuum wavenumber k is related to the wavelength λ through : $k = 2\pi / \lambda$. Using the vacuum wavenumber, the effective refractive index n_{eff} can be introduced to the ring coupling relation by the formula of propagation constant β [1].

$$\beta = k \cdot n_{eff} = 2\pi \cdot n_{eff}/\lambda \qquad \ldots . (6)$$

With the value of coupling coefficient in eqs. (5), the circulating and output intensities is given by eqs. (2) and (3) [5].

$$\left|\frac{E_3}{E_1}\right|^2 = \frac{(1-\gamma)(1-\kappa)}{(1+\kappa)^2 - 4\kappa\sin^2\left(\frac{\beta L}{2} - \frac{\pi}{4}\right)} \ldots (7)$$

$$\left|\frac{E_4}{E_1}\right|^2 = (1-\gamma) \times \left[1 - \frac{(1-\kappa)^2}{(1+\kappa)^2 - 4\kappa\sin^2\left(\frac{\beta L}{2} - \frac{\pi}{4}\right)}\right] \ldots (8)$$

By using the equation (5), we get the graph of the coupling coefficient over lambda, as shown in figure 1.

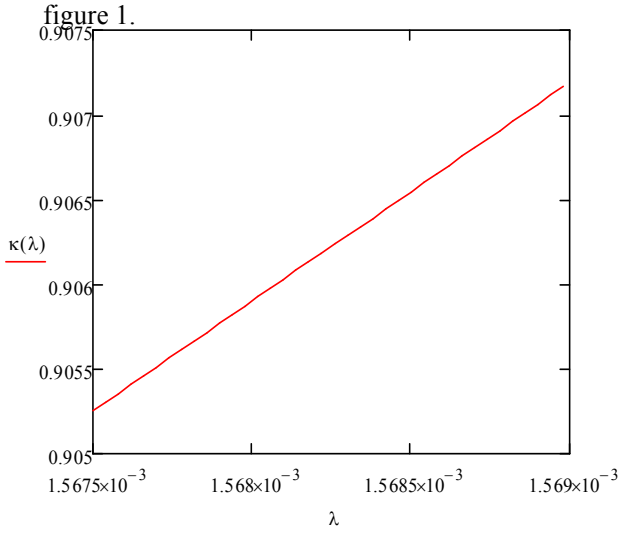


Figure 1. Graph of Coupling Coefficient over λ

III. RING RESONATOR PARAMETERS

Ring resonator filters can be described by certain figures of merit. One important figure is free spectral range (FSR) which is describe for the distance between resonance peaks. The FSR is given by :

$$FSR = \Delta\lambda = \frac{\lambda^2}{n_g L} \qquad \ldots (9)$$

where n_g is the group refractive index that can be used instead of the refractive index whenever appropriate avoiding the approximation and obtaining more accurate value. Group refractive index n_g is defined as :

$$n_g = n_{eff} - \lambda\frac{\partial n_{eff}}{\partial\lambda} \qquad \ldots (10)$$

The next important parameter of ring resonator is full width at half maximum (FWHM) that define the resonance width or 3dB bandwidth $2\delta\lambda$ of the resonance lineshape. FWHM is given by :

$$FWHM = 2\delta\lambda = \frac{\kappa^2\lambda^2}{\pi L n_{eff}} \quad \ldots(11)$$

Finesse (F) of the ring resonator is defined as the ratio of the FSR and the FWHM.

$$F = \frac{FSR}{FWHM} = \frac{\Delta\lambda}{2\delta\lambda} \quad \ldots(12)$$

A parameter which is closely related to the finesse F is the quality factor (Q), it's defined as the ratio of the operation wavelength and the resonant width.

$$Q = \frac{\lambda}{2\delta\lambda} = \frac{n_{eff}L}{\lambda}F \quad \ldots.(13)$$

The quality factor can be regarded as the stored energy divided by the power lost per optical cycle [1].

IV. STRETCHING RING RESONATOR

Using equation (7) and (8), we can get the circulating and output intensities as a function of wavelength, as shown in figure 2 below.

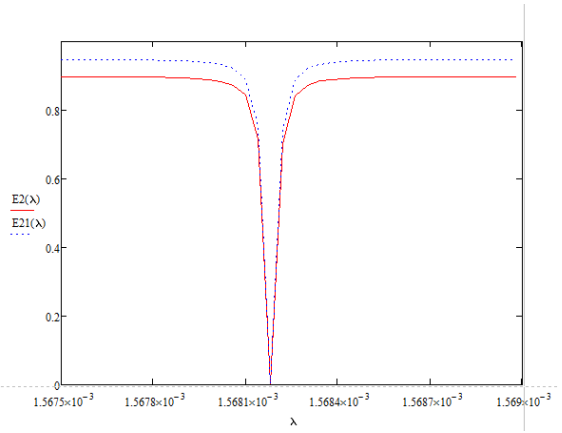
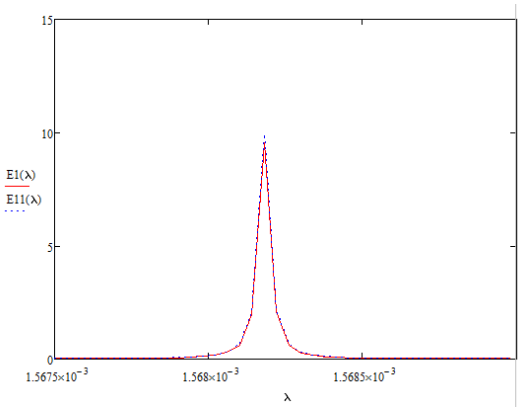


Figure 2. (a) resonator circulating intensity and (b) output intensity for 5% (blue line) and 10% coupler insertion power loss before stretching.

In this paper, the length of the ring L=200 mm, the resonant coupling coefficient κ=0.905, and distance between two cores is 20.3µm.

The circulating and output intensities in fig. 2 is not based on DWDM ITU grid specification, so the fiber stretched about ΔL, to get the intensities value base on DWDM ITU grid specification.



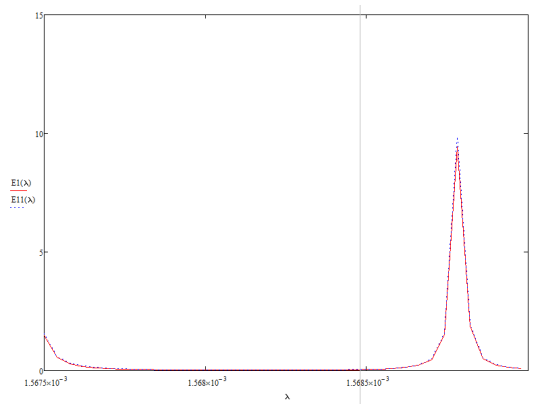


Figure 3. Resonator circulating intensity

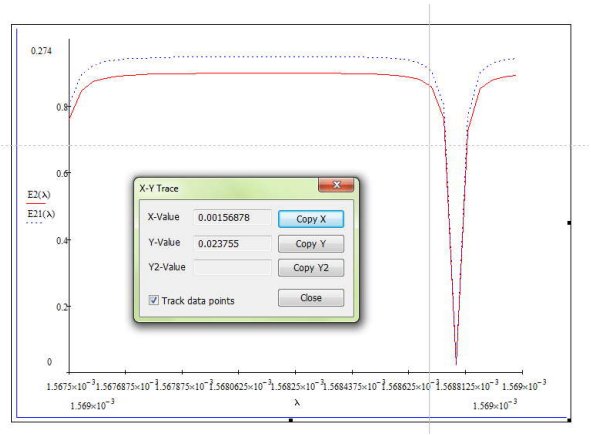


Figure 4 Resonator output intensity after stretching.

Figure 3 and 4 shown the resonator circulating and output intensity after stretching the fiber length (ring circumference). The stretched fiber process does not affect the refractive index of fiber, because the ΔL is too small. In this case, $\Delta L=0.53$ μm.

The output intensity of the stretched fiber is dropped at λ=1568.77 nm, it's one of DWDM ITU grid specification.

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