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Rays, Waves and Photons

A compendium of foundations and emerging technologies of pure and applied optics
IOP Series in Emerging Technologies in Optics and Photonics

Series Editor

R Barry Johnson a Senior Research Professor at Alabama A&M University, has been involved for over 50 years in lens design, optical systems design, electro-optical systems engineering, and photonics. He has been a faculty member at three academic institutions engaged in optics education and research, employed by a number of companies, and provided consulting services.

Dr Johnson is an IOP Fellow, SPIE Fellow and Life Member, OSA Fellow, and was the 1987 President of SPIE. He serves on the editorial board of Infrared Physics & Technology and Advances in Optical Technologies. Dr Johnson has been awarded many patents, has published numerous papers and several books and book chapters, and was awarded the 2012 OSA/SPIE Joseph W Goodman Book Writing Award for Lens Design Fundamentals, Second Edition. He is a perennial co-chair of the annual SPIE Current Developments in Lens Design and Optical Engineering Conference.

Foreword

Until the 1960s, the field of optics was primarily concentrated in the classical areas of photography, cameras, binoculars, telescopes, spectrometers, colorimeters, radiometers, etc. In the late 1960s, optics began to blossom with the advent of new types of infrared detectors, liquid crystal displays (LCD), light emitting diodes (LED), charge coupled devices (CCD), lasers, holography, fiber optics, new optical materials, advances in optical and mechanical fabrication, new optical design programs, and many more technologies. With the development of the LED, LCD, CCD and other electro-optical devices, the term ‘photronics’ came into vogue in the 1980s to describe the science of using light in development of new technologies and the performance of a myriad of applications. Today, optics and photonics are truly pervasive throughout society and new technologies are continuing to emerge. The objective of this series is to provide students, researchers, and those who enjoy self-teaching with a wide-ranging collection of books that each focus on a relevant topic in technologies and application of optics and photonics. These books will provide knowledge to prepare the reader to be better able to participate in these exciting areas now and in the future. The title of this series is Emerging Technologies in Optics and Photonics where ‘emerging’ is taken to mean ‘coming into existence,’ ‘coming into maturity,’ and ‘coming into prominence.’ IOP Publishing and I hope that you find this Series of significant value to you and your career.
I want to dedicate this book to my entire family, especially to the memory of my loving and supportive wife, who has put up with all my time at the computer and library instead of going out to eat.
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Glossary
Prologue

This book started in a very unusual way. My grandson, Garrett, was interested in Thomas Aquinas College in California. It has an unusual curriculum. All students are required to take exactly the same courses. There are only about 350 students. The curriculum consists of studying liberal arts by reading and studying the classical works written by the masters—in the original, or translations of them. It seemed like a good idea to me for philosophy, literature, and theology, but I was not so sure about mathematics and science. I learned that Euclid’s *Elements* was part of the math curriculum and that they learned optics by reading Newton’s *Opticks* and Huygens’ *Treatise of Light*. I was familiar with *Opticks*, and I tracked down and perused the other two. They were interesting reading, but certainly not good, modern texts to learn mathematics and optics. During this same time, I was also asked to review a manuscript for SPIE that traced the history of light. It took me through the works of Planck and the origin of the laser, among other topics. They were all very interesting reading, and I was turned on.

As I started my thinking about the history of optics, making an outline and recalling the significant events, I realized that I knew many of the players, and this became something of a memoir. You will immediately realize that I did not know Galileo or Newton, but I did know many of the more modern people who have contributed to many of our latter advances. I presented an award to Rudolf Kingslake, one of the first stars at the Institute of Optics and a renowned pupil of Conrady. I also presented an award to André Maréchal, a principal at the Institut d’Optique. I attended meetings with and traveled with H H Hopkins, who invented the fiber optic endoscope (with others). (The periods have been omitted after Hopkins’ initials according to IOP convention; this convention is used throughout.) Francis Turner was a colleague at Arizona and a pupil of Marianus Czerny, one of the pioneers of infrared technology and the designer of the first radiation slide rule. Francis himself was one of the pioneers in thin film technology. In fact, Francis gave me the Czerny slide rule I show in that chapter; I call it the Czerny–Turner rule. Aden Meinel, one of the inventors of the multiple mirror telescope, was director of the Optical Science Center when I was there. I collaborated with Bob Jones, one of the giants of polarized light. I had the honor of instituting the High-Speed Photography award of SPIE, commemorating Harold Edgerton.

Of course, there were even more in the infrared field, my chosen specialty. I discussed the Dove missile with Edwin Land and David Grey of Polaroid. I worked with Warren Arnquist on the 1958 edition of Proc IRE, in which he published an extensive history of the subject. I consider Stan Ballard, who organized that Proc IRE edition, to be one of my mentors. Luc Biberman, another mentor, was on the original Sidewinder team. John Jamison, who had much to do with our early missile launch detectors, was a colleague. It was Werner Weihe who gave me advice about making our mercury telluride detectors available to others. I have fond memories of discussing infrared with Bill Craven and Larry Nichols, who followed McClean in Sidewinder development. Paul Kruse, my colleague of Honeywell days, made it
possible for me to be one of the first to design systems based on mercury cadmium telluride and to continue later with microbolometer arrays.

My colleagues at the Wyant College of Optical Sciences have been invaluable in both making this a better book and educating me in their respective disciplines—Bob Shannon on lens design; Angus Maccloud on thin films and filters; Marlon Scully, Pierre Meystre, and Murray Sargent on quantum optics; Roland Shack on all sorts of classical optics; Stacey Dereniak on infrared; Jim Wyant on interferometers and organizations; Harry Barrett on medical optics and tomography; Jose Sasian on lithography; and John Grieveencamp for the many pictures from his collection of old optical instruments. John Bruning and SPIE gave me permission to use much from his fine articles on the history of lithography.

Brittani Scarpulla did an extremely thorough job editing my prose and correcting my grammar. In a true optical sense, I ground the prose into shape, and she polished it off.

I could go on, but it is enough to remember and honor many friends and colleagues who have made major contributions to modern optics. If I have not named you here, and we were good friends and colleagues, please forgive me; it would be too much to list everyone who has critiqued, criticized, commented, kibitzed, and contributed to this tome and my career. Thank you.
Figures 4.3 and 4.4 were provided by Professor John Grievencamp from his collection of old optical instruments at the James C. Wyant College of Optical Sciences at the University of Arizona.

The Optical Society graciously provide permission for the use of its logo and helped with the description.

SPIE, the International Society for Optics and Photonics, graciously gave permission for the use of its logo and several of the book images.

The Institute of Optics in the Hajim School of Engineering gave their permission for the use of their logos.

CREOL, the College of Optics and Photonics, kindly gave permission for the use of its logo.

The IRIA logo was created by me and we did not need permission.

For figure 13.6, the Boston Police Department gave permission for the use of its iconic infrared image of the Boston Bomber hiding in a boat under a polyethylene cover.
William L Wolfe

William L (Bill) Wolfe was born in Yonkers, NY on Easter Sunday in 1931. He earned a BS in physics from Bucknell University, an MS in physics and MSE in electrical engineering from the University of Michigan, where he also worked as a Research Engineer and Lecturer. He left academia for the Honeywell Radiation Center in 1966 where he was Chief Engineer and the Department Manager of the Electro-optics Systems Department. He joined what was then the Optical Sciences Center of the University of Arizona and is now the James C Wyant College of Optical Sciences as Professor of Optical Sciences in 1969. He retired as an Emeritus Professor in 1995. He is still vertical most of the day.

He was president of SPIE in 1989 and received its gold medal, its highest award, in 1999. He received Bucknell’s award as Most Successful in a Chosen Career in 1954, the Civilian Service medal from the Army, NASA Pioneer Venus Mission Achievement Award, SPIE President’s award and others.

He has consulted for many American companies, been an expert witness many times and served on advisory committees for all the military services, the National Academy of Science, the National Bureau of Standards and the Department of Justice.

He is the author of four technical books on infrared system design, radiometry and spectral imaging, two nontechnical ones on optics for the layman and fly fishing float trips; he is also the editor of two infrared handbooks, one on optics in general and an associate editor of two other optics handbooks. He was the editor of the journals: Proceedings of the Infrared Information Symposia and Infrared Physics and Technology as well as the book series Optical Physics and Technology.

He is proud of his three children who all have had professional careers and his six grandchildren all but two of whom are graduated from college.

He enjoys singing, fly fishing and crossword puzzles. He sings a few, catches a few and solves a few.

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Abstract. The development of technology in the industrial revolution 4.0 is very rapid in various sectors in trade, communication and other sectors; both nationally and internationally. One of the fields, it is the telecommunications sector. Becoming one of the digital based providers of ‘by.u’ from Telkomsel which is the first digital operator in Indonesia. The algorithm testing uses Support Vector Machine (SVM) from 300 user review data applications. The ‘by.u’ review consists of 150 negative reviews; which refers to dislike or bad expressions. Next, 150 positive reviews; which refers the constructive suggestion or support the text in using Indonesian. The resulting model gets the results of testing accuracy by using Support Vector Machine with accuracy value shows that: 87.24

1. Introduction

The development of technology in the industrial revolution 4.0 is very rapid in various sectors. There are: in trade, communication, and other sectors; both nationally and internationally. One of the fields, it is in the telecommunications sector.

In the telecommunications sector, it has a significant development, such as services in the provider companies. It happens when cellular service providers have begun to switch to the digital world. Based on the observations made by researchers, it has not many digital providers in Indonesia yet. As being stated, there is only a few of digital providers that has provided the services in Indonesia, including ‘by.u’ from Telkomsel and Switch Mobile.

Being seen from Google Playstore, ‘by.u’ has been downloaded more than 1 million by smartphone users, with 59,474 reviews. As for the Switch Mobile, it has been downloaded by more than 100 thousand users and 6259 reviews.

‘by.u’ and the Switch Mobile, they compete with each other in providing and giving digital service providers. Both have the target each other; it is toward the youth of the generation, as known as the teenager or the adolescents.

Becoming one of the digital based providers of ‘by.u’ from Telkomsel which is the first digital operator in Indonesia.
Through its new service of ‘by.u,’ this operator is removing the offline needs and replacing it with digital processes [1]. Digital services are an innovation of technological advances and massive internet penetration [2]. With all-digital services, it is able to make it easier for consumers or provider-users to make transactions, where transactions can be done independently through the ‘by.u’ as the application. That thing is able to be downloaded from a smartphone via Google Playstore.

With the existence of internet, a person will easily express his or her feelings and emotions through ratings and reviews. Due to the enhancement of textual data, so there will be a need to analyze concepts of expressing sentiments and calculate insights to explore business [3].

In a previous study entitled ”Analisis Sentimen Layanan Provider Telepon Seluler pada Twitter menggunakan Metode Naïve Bayesian Classification” where the data obtained was taken from tweets on cell phone service providers with an accuracy of 79.

In this study, sentiment analysis which is stabilized by researchers only from the sentence level using the Support Vector Machine (SVM) method, and the data taken is a digital profider review taken on the Google Play Store, using the method it is expected that researchers can produce more accuracy results higher than the previous study.

2. Methods
The method used by researchers to process the data is using the Vector Machine Support (SVM) Method. Data is taken from Google play store on ‘by.u’ application. The data that has been collected then, it will be selected according to the needs of researchers, by eliminating some of unnecessary data. After the data is selected, then the data is classified. At this stage, the data are grouped based on user reviews separated into positive and negative categories.

It has been many previous sentiment analysis studies by using the Support Vector Machine (SVM) method with different determination objects. One of them, it is about a study entitling the Sentiment Analysis of Fintech Users by Using Support Vector Machines and Particle Swarm Optimization Method [5]

The sentiment analysis aims to group user reviews into either positive or negative point of view with reference to feelings, emotions, opinions and attitudes. The classification of sentiment analysis is divided into three levels, they are the document level, sentence level, and aspect level. [6]

Support Vector Machine (SVM) is a supervised learning method that analyzes data and recognizes patterns used for classification [7]. The researcher uses the Support Vector Machine (SVM) method to analyze the sentiments of digital providers especially at the digital provider ‘by.u’ by measuring the accuracy of experimental data using the RapidMiner Studio 9.7.1 application.

In conducting trials or experiments, researchers used data comments or reviews of the Google Play Store on the ‘by.u’ application that has been filtered and obtained for about 300 data; consisting of 150 positive reviews and 150 negative reviews. So, from the positive review data and negative review data that has been separated by the same amount, it shows the ability of each review or being stored in the notepad application with extension ‘.txt’ for making easy processing toward the data.

Then from the data that has been saved with the notepad application, it will be processed by using the application RapidMiner Studio 9.7.1. As for the text processing that researchers use, it uses the Tokenize, Transform Cases, Stop Words (directory). The testing is done by selecting the Support Vector Machine (SVM) feature selection in order to get the accuracy value.

From the accuracy value of the equation confusion matrix proportion model, the number of predicted values is obtained, so it is seen of the ROC graph with the AUC (Area Under Curve) value.
Figure 1. The Model of Research

Figure 1, it explains the framework. In this study, it is began by taking a user review of ‘by.u’ application from one of the links. Then, it processes the text by using tokenize, next the change cases and stop words (directory). At the feature selection stage, it is carried out by using Classification Algorithm with Support Vector Machine (SVM). Then the results on the accuracy model is obtained by the accuracy values on the concept of data mining and ROC Curve; or the graphic results within this research.

Table 1. The Text Processing by using Tokenize, Transform Cases, and Stop words (directory)

<table>
<thead>
<tr>
<th>Text Review</th>
<th>Tokenize</th>
<th>Transform Cases</th>
<th>Stop words (Directory)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kalah sama situs</td>
<td>Kalah sama situs</td>
<td>kalah sama situs</td>
<td>kalah sama situs</td>
</tr>
<tr>
<td>judi online depo</td>
<td>judi online depo</td>
<td>judi online depo</td>
<td>judi online depo</td>
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<tr>
<td>lagsung masuk</td>
<td>lagsung masuk</td>
<td>lagsung masuk.</td>
<td>lagsung masuk.</td>
</tr>
<tr>
<td>La ini. Gk masuk</td>
<td>La ini Gk masuk</td>
<td>la ini gk masuk</td>
<td>la ini gk masuk</td>
</tr>
<tr>
<td>Saldo udah</td>
<td>Saldo udah</td>
<td>saldo udah</td>
<td>saldo udah</td>
</tr>
<tr>
<td>kepotong. Tai</td>
<td>kepotong Tai</td>
<td>kepotong tai</td>
<td>kepotong</td>
</tr>
<tr>
<td>...!!??</td>
<td>knapa bayar</td>
<td>knapa bayar</td>
<td>knapa bayar</td>
</tr>
<tr>
<td>LEWAT DANA</td>
<td>LEWAT DANA</td>
<td>lewat dana gak</td>
<td>lewat dana gak</td>
</tr>
<tr>
<td>GAK BISA....???????</td>
<td>GAK BISA</td>
<td>bisa gagal teros</td>
<td>bisa gagal teros</td>
</tr>
<tr>
<td>GAGAL TEROS.....!!!!</td>
<td>PDHL MURAH</td>
<td>pdhl murah gk</td>
<td>pdhl murah gk</td>
</tr>
<tr>
<td>PDHL MURAH</td>
<td>GK KENA</td>
<td>kena admin</td>
<td>kena admin</td>
</tr>
<tr>
<td>GK KENA ADMIN</td>
<td>ADMIN</td>
<td></td>
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</tbody>
</table>

Table 1 shows the text review. Some examples of text taken from user reviews in the ‘by.u’ application who has negative properties. If it is seen after going through Text Processing using Tokenize, Transform Cases, Stop words (directory), then the text turns into positive text. Each Text Processing has a different function, if it is paid attention to the text through Tokenize, all punctuation will be omitted such as punctuation using dots, exclamation marks and so on. Then, if the text is through the Transform Cases, all text review that uses uppercase will change become lower. Well for the last it is the case letters, if the text is through Stop words (directory) negative vocabulary or words will automatically be deleted, where the text containing negative or unpolite elements; such as the example in table 1 uses the negative word ‘t*i’ (which means
human excrement) after going through Stop words (directory) this word is automatically deleted. In this test, the study conducted a test of using the Support Vector Machine (SVM) algorithm to obtain accuracy. It will be seen as follows:

**Table 2.** The Accuracy Algorithm Support Vector Machine (SVM)

<table>
<thead>
<tr>
<th></th>
<th>True Negative</th>
<th>True Positive</th>
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<tr>
<td>Pred. Negative</td>
<td>508</td>
<td>84</td>
</tr>
<tr>
<td>Pred. Positive</td>
<td>57</td>
<td>456</td>
</tr>
</tbody>
</table>

For the table 2, ‘by.u’ application’s negative review data shows 456, which are classified into positive reviews according to predictions made by the SVM method. For 84 data, they are predicted to be positive reviews but it turns out that the results of predictions are negative reviews. For by.u’s negative review data, 508 were classified as negative reviews according to predictions made with the SVM method. While for 57 data that predicted negative reviews, it turned out to be positive review results. With accuracy by using Support Vector Machine (SVM), it has the accuracy value of: 87.24 In this study, to get the value of model accuracy such as confusion matrix and ROC Curve, researchers used RapidMiner Studio by using the Support Vector Machine (SVM) algorithm, it is called by applying the Modelling Validation Testing as follows:

![Modelling Validation Testing Support Vector Machine](image)

**Figure 2.** Modelling Validation Testing Support Vector Machine

In Figure 2, that is clearly seen where the Text Processing process uses Tokenize, Transform Cases, Stop words (Directory). Likewise, the algorithm used by researchers uses Support Vector Machine (SVM). Meanwhile, to get a graph or the results of the ROC Curve in this study, it is by applying the Modelling Validation Testing on Support Vector Machine (SVM) as follows:
In Figure 3, the results of the ROC Curve Support Vector Machine (SVM) study on ROC graph research with AUC states: \(0.942 \pm 0.012\) (micro average: 0.942) (positive class: Positive).

### 3. Conclusion

The algorithm testing uses Support Vector Machine (SVM) from 300 user review data applications, 'by.u' review consists of 150 negative reviews or unpolite expression. Then, 150 positive reviews or constructive suggestion or supporting the text in using Indonesian. The resulting model gets the results of testing accuracy using Support Vector Machine with accuracy value: 87.24

### References

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