

**LEMBAR**  
**HASIL PENILAIAN SEJAWAT SEBIDANG ATAU *PEER REVIEW***  
**KARYA ILMIAH : PROSIDING INTERNASIONAL**

Judul Prosiding (Artikel) : Weakly compact linear operators on space of Dunford integral function  
Nama/ Jumlah Penulis : Solikhin, Susilo Hariyanto, Y D Sumanto, A Aziz  
Status Pengusul : penulis ke-1  
Identitas Prosiding :  
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NIP. 195809011986032002  
Unit Kerja : FSM Undip  
Bidang Ilmu : Matematika

Reviewer 2

Nama : Drs. Bayu Surarso, M.Sc Ph.D.  
NIP. 19631105 198803 1 001  
Unit Kerja : FSM Undip  
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Semarang, 4 Maret 2023  
Reviewer 1

  
Nama : Prof. Dr. Sunarsih, M.Si.  
NIP. 195809011986032002  
Unit Kerja : FSM Undip  
Bidang Ilmu : Matematika

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**2. Ruang lingkup dan kedalaman pembahasan:**  
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Semarang, Februari 2023  
Reviewer 2



Nama : Drs. Bayu Surarso, M.Sc Ph.D.  
NIP. 19631105 198803 1 001  
Unit Kerja : FSM Undip  
Bidang Ilmu : Matematika

# Weakly compact linear operators on space of Dunford integral function

Solikhin S. ; Hariyanto S.; Sumanto Y.D.; Aziz A.

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<sup>a</sup> Department of Mathematics, Faculty of Science and Mathematics Diponegoro University, Jl. Prof. Soedarto, S.H., Semarang, 50275, Indonesia

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## Abstract

This study discussed the integral of Dunford and compact linear operator on space of Dunford integral function. For each  $f$  which is Dunford integral on  $[a, b]$  is defined as an operator  $DL$  by  $DL(x \circledast) = x \circledast f$ , for each  $x \circledast \in X \circledast$ . This study resulted that the operator  $DL$  is both a continuous linear operator and weakly compact operators. Then, it was defined as the adjoint of the operator by each  $h \in (L^1) \circledast$ . The adjoint operator is continuous and weakly compact linear operators. © Published under licence by IOP Publishing Ltd.

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The Henstock Integral for Banach-valued Functions  
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doi: 10.1016/j.jmaa.2006.08.020  
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# **The 9th International Seminar on New Paradigm and Innovation on Natural Science and Its Application**

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**Counting the number of vertexes labeled connected graphs of order five with minimum five edges and maximum ten parallel edges**

Amanto, Notiragayu, F C Puri, Y Antoni and Wamiliana

## Isolation and identification of rare actinomycete-like bacteria from soil-based on 16S ribosomal RNA gene sequences

Y Eshananda<sup>1</sup>, F Ningsih<sup>1,2</sup>, Y Sakai<sup>3,4</sup>, A Yokota<sup>3</sup>, S Yabe<sup>3,4</sup>, W Sjamsuridzal<sup>1,2</sup>

<sup>1</sup>Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Kampus UI Depok, Depok 16424, Indonesia

<sup>2</sup>Center of Excellence for Indigenous Biological Resources-Genome Studies, Faculty of Mathematics and Natural Sciences, Universitas Indonesia, Kampus UI Depok, Depok 16424, Indonesia

<sup>3</sup>Department of Microbial Resources, Graduate School of Agricultural Science, Faculty of Agricultural, Tohoku University, 468-1 Aoba, Aramaki, Sendai, Miyagi 980-0845, Japan

<sup>4</sup>Hazaka Plant Research Center, Kennan Eisei Kogyo Co., Ltd., 44 Aza-Inariyama, Oaza-Ashitate, Murata-Cho, Shibata gun, Miyagi 989-1311, Japan.

Corresponding author: yuriza.eshananda@ui.ac.id

**Abstract.** The rare actinomycete-like bacteria are mycelium-forming bacteria other than phylum *Actinobacteria* that difficult to isolate and cultivate. This group of bacteria was recently speculated by many scientists as a potential new microbial resource for the discovery of novel compounds, as a substitute for actinomycetes. In this study, we isolate and identify rare actinomycete-like bacteria from forest soil collected under bamboo trees, near the Cisolok Geysers, Sukabumi, Indonesia. The isolation of bacteria was performed using Reasoner's 2A (1:10 dilution) medium with 2% gellan gum instead of agar and incubated at 30 °C for three weeks. The 16S rRNA gene sequences of the isolates were examined to determine their taxonomic position. Four isolates designated K17-1, K17-2, K42, and K44 showed pale oranges colonies and formed mycelia were obtained. The results of 16S rRNA gene sequences of these isolates showed high similarity to members of the genus *Dictyobacter* in the family *Dictyobacteraceae* of the class *Ktedonobacteria* of the phylum *Chloroflexi*, with values 97.16-98.02%, and most closely related to the species *Dictyobacter aurantiacus* S-27<sup>T</sup> (97.16-98.02% similarities). This result suggested that the member of the class *Ktedonobacteria*, which considered as rare actinomycete-like bacteria, such as *Dictyobacter* could be found in the forest soil of the geothermal area.

### 1. Introduction

*Actinobacteria* are gram-positive bacteria that have a high percentage of guanine and cytosine in their genome [1]. This group morphologically comprises unicellular organisms to mycelium-forming bacteria which called Actinomycetes [1,2]. However, bacteria that have filamentous appearance also could be found in the phylum *Chloroflexi*. The member of this phylum which has actinomycete-like morphology is present in the four different class namely *Chloroflexi*, *Anaerolineae*, *Caldilineae* and *Ktedonobacteria* [3]. Among these class, *Ktedonobacteria* has some obvious morphological features which distinguish themselves from others. The member of *Ktedonobacteria* are aerobic organism and forming branched mycelia with spores like actinomycetes [3,4]. Moreover, most validly published strains of *Ktedonobacteria* budding their multiple spores per cell on the aerial mycelium which unique among bacteria [5]. All of *Ktedonobacteria* identified as gram-positive bacteria while almost of the member in phylum *Chloroflexi* were gram-negative [3,6]. Based on these exceptional characters, class *Ktedonobacteria* could be included as the rare actinomycete-like bacteria.

Rare actinomycete-like bacteria could provide an alternative for the discovery of new compounds derived from microorganisms because spore formation usually would be followed by the production of secondary metabolites [7,8]. Further analysis of the genomic of nine members of rare actinomycete-like bacteria



# Hoax news validation using similarity algorithms

S Y Yuliani<sup>1,2</sup>, S Sahib<sup>2</sup>, M F Abdollah<sup>2</sup>, Y S Wijaya, N H M Yusoff

<sup>1</sup>Information Security and Networking Research Group (InFORSNET), Faculty of Information Communication Technology, Universiti Teknikal Malaysia Melaka Malaka, **Malaysia**

<sup>2</sup>Informatic Department, Faculty Engineering, University Widyatama Bandung, Indonesia

Corresponding author: sy.yuliany@gmail.com

**Abstract.** News that is presented every day on social media dramatically affects the feelings, feelings, thoughts, or even actions of a person or group. Hoax News is one of them which is disturbing the public and raising noise in various fields, ranging from politics, culture, security, and order, to the economy. Inseparable from social media users. How every day, there is information on social media, which is not necessarily true so that people are provoked by hoax on social media. The news detection system in this study was designed using Unsupported Learning so that it does not require data training. The system was built using the Equation algorithm to calculate the validity of document similarity. Extraction results used to search for content related to user input using a detection engine, then the similarity value and the time needed to utilize hoax news are calculated. System validation testing by using a four text similarity algorithm called the Equation algorithm, the Levenshtein algorithm, the Smith-Waterman algorithm, the Damerau Levenshtein algorithm; this algorithm is used to find the best analytical solution of news hoaxes and submissions needed to find the news hoax password. The final results of the deception detection research using a script that has been done for Validation using an algorithm, get the value of accuracy in detection using the Smith-Waterman algorithm, which produces an accuracy value of text similarity of 99.29% and can be used a process of 6, 57 seconds, followed by the second sequence that is the similarity algorithm produces an accuracy of 75% and requires a processing time of 4.94 seconds, then the third sequence is the Levenshtein algorithm with an accuracy of 55.02% and requires a processing time of 5.49 seconds, and is used today is Damerau Levenshtein algorithm is 55.02% and requires a processing time of 7.54%. The results of research tests on this text can conclude the more text on the detection engine, the higher the verification value and the higher the time needed to process hoax news.

## 1. Introduction

Sharing information is a positive thing, but not all information disseminated through social media is in the form of facts. There have been various cases of spreading the news that is not facts or often called hoaxes. Whereas hoax is critical information that misleads human perception by spreading false information but considered as valid, No wonder then the intensity of fake news and hoax news on social media is so viral on social media [1]. For personal and group benefit by spreading harmful content that caused unrest and mutual suspicion in the community [2]. The ease and speed of dissemination on social media make this hoax news known to many people in a relatively short period, and can to more people.



# Weakly compact linear operators on space of Dunford integral function

*by* Susilo Hariyanto

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## Weakly compact linear operators on space of Dunford integral function

S Solikhin, S Hariyanto, Y D Sumanto, A Aziz

Department of Mathematics, Faculty of Science and Mathematics  
Diponegoro University, Jl. Prof. Soedarto, S.H. Semarang, 50275

Corresponding author: [soli\\_erf@yahoo.com](mailto:soli_erf@yahoo.com)

**Abstract.** This study discussed the integral of Dunford and compact linear operator on space of Dunford integral function. For each  $f$  which is Dunford integral on  $[a, b]$  is defined as an operator  $D_L$  by  $D_L(x^*) = x^*f$ , for each  $x^* \in X^*$ . This study resulted that the operator  $D_L$  is both a continuous linear operator and weakly compact operators. Then, it was defined as the adjoint of the operator  $D_L^*$  by  $D_L^*(h)(x^*) = \int_a^b h D_L(x^*)$  each  $h \in (L_1)^*$ . The adjoint operator  $D_L^*$  is continuous and weakly compact linear operators.

### 1. Introduction

In many applications, for example in differential equations, optimization and so forth do not rule out the possibility of integral problems faced with Banach  $X$  valued functions. The study of integral theory for Banach's valued functions has developed and it becomes an interesting topic for researchers. Many researchers study the integral theory of a Banach-valued or vector-valued function which is the development of a real-valued function. For example, such as the Bochner integral [1], the Henstock-Bochner integral [2],  $\mu$ -integral  $\mu$ -integral  $\mu$ -integral [3],  $\mu$ -function [4], and Dunford integrals [5].

Integral Bochner was introduced by Salomon Bochner. He extended the Lebesgue integral definition [6] into the Banach valued function. The function  $f$  of a closed interval  $I$  into the Banach space  $X$  is Bochner integrable if there is a sequence of simple functions  $(f_n), \forall n \in \mathbb{N}$  such that  $\lim_{n \rightarrow \infty} \int_I \|f_n - f\| d\mu = 0$  [5]. As for the Dunford integral, it defines the integral of a weakly measurable

function. The  $(X^*)^*$   $(X^*)$  is  $(X^*)$  the  $(X^*)$  real-valued function  $\mu$  is Lebesgue integrable [5].

Studies for Dunford integrals have been expanded into Riemann type integrals, such as  $\mu$ -Dunford  $\mu$ -Henstock-Pettis  $\mu$  [7]. The integration of Henstock-Dunford requires that the function of real value  $x^*f$  integral Henstock [8]. Integrated into Henstock [8]. Not only limited to this, but the Henstock-Dunford integral is also generalized in the Euclidean space, namely the Henstock-Dunford integral in the Euclidean space.



The study of integral theory is also combined with operator theory. Several properties of the positive Dunford-Pettis operator [9] have been discussed. Operators working in the space of Bochner integrable function. Next, operators are examined in the space of Dunford integrable function [10].

Taking into account the results of operator studies on space of Dunford integrable function, it will be examined more specifically about weakly compact operators and adjoint operators [11] on space of Dunford integrable function. How are the weakly compact operators and its adjoint operator and the relationship of the two operators.

## 2. Weakly measurable functions

The following discusses the measurable functions and weak measurable functions valued at Banach.

**Definition 2.1** [5] Let  $f: [a, b] \rightarrow X$  be a function, where  $X$  is a Banach space.  $f$  is called a simple function if there is a measurable set  $A_k \subset [a, b]$ ,  $k = 1, 2, \dots, q$  so that  $A_k \cap A_j = \emptyset$ , for each  $k \neq j$  and  $[a, b] = \bigcup_{k=1}^q A_k$ , where  $f(x) = y_k \in X$  for  $x \in A_k, k = 1, 2, \dots, q$ .

Based on simple functions, measurable functions can be defined as follows.

**Definition 2.2** [5] A function  $f$  is said to be measurable if there is a simple sequence of functions  $(f_k), k \in N$  with

$$\lim_{k \rightarrow \infty} \|f_k(x) - f(x)\|_X = 0,$$

for almost all  $x \in [a, b]$ .

According to Definition 2.2, so simple functions are measurable functions. Furthermore, if the  $f$  is a measurable function, then the real function  $\|f\|_X$  is also a measurable function.

**Theorem 2.3** [5] If  $f$  is a measurable function, then the real function  $\|f\|_X$  is measurable.

**Proof:** Because  $f_k$  functions are measurable, there are simple functions such  $(f_k), k \in N$  so that

$$\lim_{k \rightarrow \infty} \|f_k(x) - f(x)\|_X = 0$$

for each  $x \in [a, b]$ . Because  $f_k$  it is a simple function for all  $k \in N$ , therefore  $\|f_k\|_X$  it is also a simple function for all  $k \in N$ . Therefore,  $f_k$  the function is measurable so it applies

$\|f_k\|_X$  is measurable. This means  $\lim_{k \rightarrow \infty} \|f_k\|_X = \|f\|_X$  measurable.  $\square$

**Definition 2.4** [5] A function  $f$  is said to be weakly measurable if  $f(x) \in X^*$  for almost all  $x \in [a, b]$ .

Each measurable function is weakly measurable function.

**Theorem 2.5** [5] If  $f$  is a weakly measurable function, then  $f$  is measurable.

**Proof:** Measured  $f$  function, meaning there is a simple sequence of functions  $(f_k), k \in N$  so that

$$\lim_{k \rightarrow \infty} \|f_k(x) - f(x)\|_X = 0$$

for almost all  $x \in [a, b]$ .

Taken arbitrarily  $\epsilon > 0$ , then apply

$$\|f_k(x) - f(x)\|_X < \epsilon$$

and  $\lim_{k \rightarrow \infty} \|f_k\| = 0$ . So,  $f$  is weakly measurable.  $\square$

Based on the measurable function of weak lemma construction which will guarantee the existence of the Dunford integral.

**Lemma 2.6 Dunford** [5] Assume  $X$  is a Banach space and  $X^*$  its dual. If  $f: [a, b] \rightarrow X$  is weakly measurable and  $f$  is of real-valued  $f: [a, b] \rightarrow \mathbb{R}$  is Lebesgue integrable i.e.,  $x^* f \in L_1$ , then for each measurable set  $A \subset [a, b]$  there exists a unique  $x_{(f,A)}^* \in X^*$  such that

$$x_{(f,A)}^*(f(t)) = \int_A f(t) dt$$

for every  $x^* \in X^*$ .

**Proof:** [5, 10]  $\square$

### 3. Dunford integral

The definition of the Dunford integral is given and it is shown

**Definition 3.1** [5] Assume  $X$  is a Banach space and  $X^*$  its dual. The function  $f: [a, b] \rightarrow X$  is said to be Dunford integrable on  $[a, b]$  if each scalar function  $x^* f$  is Lebesgue integrable and for each set of measurable  $A \subset [a, b]$  there exists a unique  $x_{(f,A)}^* \in X^*$  such that

$$x_{(f,A)}^*(f(t)) = \int_A f(t) dt$$

for every  $x^* \in X^*$ .

The Dunford integral is denoted by  $D_L[a, b]$ . For  $f \in D_L[a, b]$  means that  $f$  is Dunford integrable on  $[a, b]$ .

**Theorem 3.2** [10] If  $f \in D_L[a, b]$ , then for every single measurable set  $A \subset [a, b]$  vector  $x_{(f,A)}^* \in X^*$  is single.

**Proof:** [10].

Examples of Dunford integrable functions are constant functions, continuous functions, Riemann integrable functions, Lebesgue integrable functions [10] and so on.

**Theorem 3.3** [5] Dunford integrable function  $f: [a, b] \rightarrow X$  is Lebesgue integrable on  $[a, b]$ .

**Proof:** Based on Definition 3.1, Dunford integrable function  $f: [a, b] \rightarrow X$  is Lebesgue integrable on  $[a, b]$ . Conversely, if the real function  $x^* f$  is Lebesgue integrable on  $[a, b]$ , then  $f$  is Dunford integrable on  $[a, b]$ .

It was further shown that the collection of all functions  $f$  that Dunford integrated on  $[a, b]$ , is linear space.

**Theorem 3.4** The collection of all functions  $f$  that Dunford integrated on  $[a, b]$ ,  $D_L[a, b]$  is linear space.

**Proof:** Let  $f, g \in D_L[a, b]$  arbitrarily  $c \in \mathbb{R}$ . It shows that  $f + g \in D_L[a, b]$  and  $cf \in D_L[a, b]$ . For  $f, g \in D_L[a, b]$ ,  $x^* f, x^* g \in L_1[a, b]$  and  $x^* g$  are Lebesgue integrable on  $[a, b]$ . So that for any  $x^* \in X^*$   $(x^* f + x^* g) = x^* (f + g)$  is Lebesgue integrable on  $[a, b]$ . So, the

function  $f + g$  is Dunford integrable on  $[a, b]$ . Furthermore, for any scalar  $c \in R$  and  $f \in L_1$ ,  $(cf)(x) = cx^*(x)$  Lebesgue integrable on  $[a, b]$ . So, the function  $cf$  is Dunford integrable on  $[a, b]$ .

#### 4. Weak compact operators on space of Dunford integral function

Suppose  $X$  is dual  $X^*$  and  $L_1$  dual  $X^*$ . By  $L_1$  is space of Lebesgue integrable functions on  $[a, b]$ .

Defined operator  $D_L : X^* \rightarrow L_1$  by

$$D_L(x^*) = x^*f,$$

for every  $x^* \in X^*$ .

The operator  $D_L$  as in the definition is a bounded linear or continuous linear operator.

**Theorem 4.1** [5] *The operator  $D_L$  is a bounded linear operator.*

**Proof:** Let arbitrarily  $x^*, z^* \in X^*$  and arbitrarily  $c \in R$ . We obtained

$$\begin{aligned} D_L(x^* + z^*) &= (x^* + z^*)f \\ &= x^*f + z^*f \\ &= D_L(x^*) + D_L(z^*), \end{aligned}$$

and

$$D_L(cx^*) = (cx^*)f = cx^*f = cD_L(x^*).$$

So it's a linear operator. Furthermore, according to the Closed Graph Banach Theorem, operators  $D_L$  are bounded.  $\square$

**Lemma 4.2** [11], [12] *The dual space  $L_1$  is  $L_\infty$ , i.e.  $L_1^* = L_\infty$ .*

**Proof:** For each  $y = \{y_n\} \in L_\infty$  functional formed  $f_y$  on  $L_1$  by

$$f_y(x) = \sum_{n=1}^{\infty} x_n y_n.$$

We obtained that  $f_y$  linear and continuous, i.e. for any  $x = \{x_n\}, z = \{z_n\} \in L_1$  and any scalar  $c \in R$  gives

$$f_y(x+z) = \sum_{n=1}^{\infty} (x_n + z_n) y_n = f_y(x) + f_y(z) \text{ and } f_y(cx) = \sum_{n=1}^{\infty} (cx_n) y_n = cf_y(x).$$

Furthermore for each  $x = \{x_n\} \in L_1$  gives

$$|f_y(x)| = \left| \sum_{n=1}^{\infty} x_n y_n \right| \leq \|x\|_1 \|y\|_\infty.$$

So that each  $y = \{y_n\} \in L_\infty$  determines with a single functional linear continuous  $f_y$  at  $L_1$ , or  $L_\infty \subset L_1^*$ .

Instead, take any continuous functional linear  $f$  on  $L_1$ . For each,  $x = \{x_n\} \in L_1$  it can be represented by

$$x = \sum_{n=1}^{\infty} x_n e_n,$$

with  $e_n = \left\{ 0, \dots, 1, 0, \dots, 0 \right\}_n$ .

Since  $f$  is linear,

$$f(x) = f\left(\sum_{n=1}^{\infty} x_n e_n\right) = \sum_{n=1}^{\infty} x_n f(e_n).$$

This means that  $f(x)$  it is a linear combination of rows of numbers  $\{f(e_n)\}$  or continuous linear functional  $f$  depending on rows of numbers  $\{f(e_n)\}$ .

Furthermore, because the function  $f$  is continuous, so  $|f(x)|$  bounded, that is  $|f(x)| < \infty$ . According to the Cauchy-Schwartz Inequality, it was obtained

$$\left| \sum_{n=1}^{\infty} x_n f(e_n) \right| \leq \left( \sum_{n=1}^{\infty} x_n^2 \right)^{1/2} \left( \sum_{n=1}^{\infty} f(e_n)^2 \right)^{1/2} = \|x\|_{L_2} \left( \sum_{n=1}^{\infty} f(e_n)^2 \right)^{1/2}.$$

So that  $|f(x)|$  bounded it must be  $\sup_{n \geq 1} |f(e_n)| < \infty$ . This means that  $y = \{f(e_n)\} \in L_{\infty}$ .

Thus, any continuous linear function  $f$  in  $L_1$  determining with a single vector  $y = \{f(e_n)\} \in L_{\infty}$ , then  $L_1^* \subset L_{\infty}$ .

So, that  $L_{\infty} \subset L_1^*$  and  $L_1^* \subset L_{\infty}$ , so  $L_1^* = L_{\infty}$ .  $\square$

For each  $f \in D_L[a, b]$  defined  $D_L^*: L_1^* \rightarrow X^{**}$  by an operator

$$D_L^*(h)(x^*) = \int_a^b h D_L(x^*) = \int_a^b h x^* f,$$

for every  $h \in L_1^* = L_{\infty}$ .

An operator  $T^*$  is called adjoint operators against operators  $T: X^* \rightarrow L_1$  on  $L_1$ .

**Theorem 4.3** [5] *The adjoint operator  $D_L^*$  is bounded linear operators and*

$$\|D_L^*\| = \|D_L\|.$$

**Proof:** The operator adjoint  $D_L^*$  linear for arbitrary  $h_1, h_2 \in L_1^* = L_{\infty}$  and any scalars  $c_1, c_2 \in \mathbb{R}$  gives

$$\begin{aligned} D_L^*(c_1 h_1 + c_2 h_2)(x^*) &= \int_a^b (c_1 h_1 + c_2 h_2) D_L(x^*) = c_1 \int_a^b h_1 D_L(x^*) + c_2 \int_a^b h_2 D_L(x^*) \\ &= c_1 D_L^*(h_1)(x^*) + c_2 D_L^*(h_2)(x^*). \end{aligned}$$

Because  $f \in D_L[a, b]$  and  $\|x^*\| = 1$  then  $\|D_L^*(h)\| \leq \|h\| \|D_L\|$ .

So,

$$\|D_L^*\| \leq \|D_L\|.$$

For each  $x_0^* \neq \theta \in X^*$  there is  $h_0 \in L_1^*$  with  $\|h_0\| = 1$  and  $h_0(D_L(x_0^*)) = \|D_L(x_0^*)\|$ .

So,

$$h_0(D_L(x_0^*)) = D_L^*(h_0)(x_0^*).$$

Let  $f_0 = D_L^*(h_0)$  and obtained

$$\|D_L(x_0^*)\| = h_0(D_L(x_0^*)) = f_0(x_0^*) \leq \|f_0\| \|x_0^*\| = \|D_L^*(h_0)\| \|x_0^*\| \leq \|D_L^*\| \|h_0\| \|x_0^*\|.$$

Since  $\|h_0\| = 1$ , so for every  $x_0^* \neq \theta \in X^*$  such that  $\|D_L(x_0^*)\| \leq \|D_L^*\| \|x_0^*\|$ .

So,

$$\|D_L\| \leq \|D_L^*\|.$$

Because  $\| \cdot \|$  and  $\| \cdot \|$ , then  $\| \cdot \|$ .

**Theorem 4.4** If  $D_L : X^* \rightarrow L_1$  and  $T_L : X^* \rightarrow L_1$  are bounded linear operators and any scalar  $c \in R$ , then

$$(i) (D_L + T_L)^* = D_L^* + T_L^*.$$

$$(ii) (cD_L)^* = cD_L^*.$$

$$(iii) \| \cdot \|^2 = \| \cdot \|^2.$$

**Proof:** (i)  $(D_L + T_L)^*(x^*) = \int h(D_L + T_L)(x^*) = \int hD_L(x^*) + \int hT_L(x^*) = D_L^*(h)(x^*) + T_L^*(h)(x^*)$

$$(ii) (cD_L)^*(h)(x^*) = \int_a^b h(cD_L)(x^*) = c \int_a^b hD_L(x^*) = cD_L^*(h)(x^*).$$

(iii) Because  $D_L$  and  $D_L^*$  are bounded linear operators and  $\| \cdot \|$ , then

$$\| \cdot \|^2 = \| \cdot \|^2. \quad \square$$

If  $f \in [a, b]$  the adjoint operator

**Theorem 4.5** [5] Assume  $D_L$  is a Dunford operator  $D_L : X^* \rightarrow L_1$  is a bounded linear operator. the operator  $D_L^* : L_\infty \rightarrow L_\infty$  is a bounded linear operator.

: According to Gantmacher's theorem, the operator  $D_L$  is a bounded linear operator. operator  $D_L^*$  also a bounded linear operator.  $\square$

## 5. Conclusion

Based on the results of the discussion outlined in the form of several theorems, it can be concluded that the collection of all functions integrated Dunford is linear space. For each function which is Dunford integral can be constructed by an operator. Its continuous linear operator and weakly compact operators. Furthermore, the adjoint operator is continuous and weakly compact linear operators.

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