

# Web Link Analysis and Web Impact Factors of Space Science Libraries' Websites

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## **Abstract**

*The purpose of the library website is to provide service and disseminate information to the intended users. The paper aims to analysis the space science libraries' websites in the world and their web link analysis, web impact factor and its ranking. The study has been carried out on 17 space science libraries' websites. For the analysis, the data collected on number of web pages, external links, in-links, self-links, total links of the websites. Various web impact factors were calculated on the basis of the web links and ranked the websites.*

**Keywords:** Webometrics, Web Link Analysis, Web Impact Factor, Space Science Libraries' Websites

## **1. Introduction**

The function of the library website is to organize information and provide access to collections of quality resources. It provides information about library hours, policies, and contact information. Users can access the library online 24 hours a day, seven days a week from internet. It acts as interactive information and web based services to the users. Any service needs evaluation, assessment and usability.

The criteria for the evaluation of websites have been developed on the basis of few studies. One of the criteria of evaluating websites, is to calculate Web Impact Factor (WIF) and compare their attractiveness and efficiency which can be measured through determining number of in-links, self-links, co-links and out-links.

The question of need for measuring the web started as early as in 1996. Bray (1996) tried to analyze how big is the Web, what is the average page like, how richly connected, what are the biggest and most visible sites and felt to devise a way to automatic gen-

eration of these statistics and their graphical representation. Almind and Ingwersen (1997) have introduced the idea of possible to use informetric methods on World Wide Web (WWW), called Webometrics. It covers research of all network-based communication using informetric or other quantitative measures. Their study presented a workable method for informetric analyses with number of parameters such as domain analysis, web pages, relationship between web pages, document type, web structure, etc.

## **2. Review of Related Literature**

Aminpour and others (2009) conducted Webometric analysis of Iranian universities of medical sciences. In a cross-sectional study, the number of web pages, in-links, external links and also the overall and absolute WIFs for Iranian universities of medical sciences with active exclusive websites were calculated. Finally, the websites were ranked based on these webometric indicators.

Jeyshankar and Ramesh Babu (2009) examined and explored through a webometric study of the websites of 45 universities in Tamil Nadu comprising of 27 state and 18 private universities. Identified



the domain systems of the websites; analyses the number of web pages and link pages, and calculated the simple WIF, self-link WIF and external WIF of the University websites in Tamil Nadu and ranked the websites as per the WIF.

Walia and Kaur (2010) carried out a study on Government of India websites. They highlighted the importance of online government information in India and showed how far these websites have been able to make an impact on the society. They examined the websites for their linking and content presence, and also to find out their web impact factor.

Goltaji and Shirazi (2012) felt that research centers are among the most important institutes in a scientific society. Using the AltaVista search engine and webometric methods, their research tries to find the performance and impact of the top research centers of the Islamic World Countries. The results revealed that from 57 countries, 40 of them did not have any research centers scored in webometric ranking and the rest of them had not been scored well in the webometric ranking model. They ranked research centers' websites based on some webometric indicators such as number of pages, linkages, WIF and Revised WIF.

Thelwall (2012) opined that the value of webometrics quickly became established through the Web Impact Factor, the key metric for measuring and analyzing website hyperlinks. Link analysis became more focused as link impact analysis and link network analysis, taking the quantity of links as a reflection of research productivity or prestige.

Satpathy and Maharana (2012) attempted to study websites of National Institute of Technology (NIT) of India using WIFs. The simple WIF, self-link WIF,

external WIF and revised WIF of the NITs under the scope of study have been calculated. The study revealed that some NITs have higher number of web pages but their link pages are very small in numbers and websites fall behind in their simple, self-link and external link WIF.

Jalal (2013) investigated the relationship among top ten world universities (TTWU), top ten Asian universities (TTAU) and top ten Indian universities (TTIU) based on the exploratory study of web link analysis. In-links and out-links analysis try to explore the relationship among these universities.

### 3. Objectives

The objective of the study is to analysis the Space Science Libraries' Websites and their web links, web impact factor and its ranking. The objectives are:

- ▶ To trace websites of Space Science Libraries at National and International level;
- ▶ To collect and analyze the number of web pages, the number of link pages, number of self link pages and external link pages of Space Science Libraries' Websites;
- ▶ To calculate the Web Impact Factor (WIF) of Space Science Libraries' Websites and Ranking.

### 4. Scope and Limitations

The analysis has been carried out on space science library websites in the world. Space science studies makes to look outwards from Earth, towards the stars and various science fields which relate to space flight or any phenomena occurring in space or on other planets. Space research is scientific studies carried out using scientific equipment in outer space. It

includes the use of space technology for a broad spectrum of research disciplines.

The analysis was conducted on space science libraries' websites at national and international level for

proper comparative analysis. It was ascertained that space science research are carried out in 93 institutions from 46 countries. Out of which only 17 space science library websites are available in 11 countries. These are listed in Table 1 and included in the study.

**Table 1: List of the Websites of Space Science Libraries at National and International Level**

S.N.	Space Science Library	Country	Website
1	Indian Institute of Space Science and Technology Library	India	<a href="http://www.iist.ac.in/facilities/library">http://www.iist.ac.in/facilities/library</a>
2	Indian Institute of Remote Sensing Library	"	<a href="http://www.iirs.gov.in/centrallibrary">http://www.iirs.gov.in/centrallibrary</a>
3	INPE - National Institute for Space Research Library	Brazil	<a href="http://www.inpe.br/biblioteca/">http://www.inpe.br/biblioteca/</a>
4	Canadian Space Agency (CSA) Library	Canada	<a href="http://www.asc-csa.gc.ca/eng/library/default.asp">http://www.asc-csa.gc.ca/eng/library/default.asp</a>
5	International Space University Library	France	<a href="http://isulibrary.isunet.edu/opac/">http://isulibrary.isunet.edu/opac/</a>
6	Italian Space Agency Library	Italy	<a href="http://www.asi.it/en/activity/information">http://www.asi.it/en/activity/information</a>
7	Institute of Space and Astronautical Science Library	Japan	<a href="http://www.isas.jaxa.jp/biblio/e">http://www.isas.jaxa.jp/biblio/e</a>
8	Institute of Space Technology Library	Pakistan	<a href="http://www.ist.edu.pk/library">http://www.ist.edu.pk/library</a>
9	Space Research Centre Library, Polish Academy of Sciences	Poland	<a href="http://biblio.cbk.waw.pl/">http://biblio.cbk.waw.pl/</a>
10	National Institute of Aerospace Research Library	Romania	<a href="http://www.incas.ro/index.php?option=com_content&amp;view=article&amp;id=154&amp;Itemid=11">http://www.incas.ro/index.php?option=com_content&amp;view=article&amp;id=154&amp;Itemid=11</a>
11	Space Research Institute Library	Saudi Arabia	<a href="http://www.kacst.edu.sa/en/services/requestforinformation/Pages/servicesprovided.aspx">http://www.kacst.edu.sa/en/services/requestforinformation/Pages/servicesprovided.aspx</a>
12	Center for Astrophysics & Space Sciences Library, University of California	United States	<a href="http://cass.ucsd.edu/archive/marlar/index.html">http://cass.ucsd.edu/archive/marlar/index.html</a>
13	University of Tennessee Space Institute Library	"	<a href="http://www.utsi.edu/library/">http://www.utsi.edu/library/</a>
14	National Aeronautics and Space Administration (NASA) Headquarters Library	"	<a href="http://www.hq.nasa.gov/office/hqlibrary/index.html">http://www.hq.nasa.gov/office/hqlibrary/index.html</a>
15	NASA Ames Research Centre Library	"	<a href="http://ameslib.arc.nasa.gov/">http://ameslib.arc.nasa.gov/</a>
16	Space Science and Engineering Centre Library, University of Wisconsin-Madison	"	<a href="http://library.ssec.wisc.edu/">http://library.ssec.wisc.edu/</a>
17	Space Telescope Science Institute Library	"	<a href="http://www.stsci.edu/institute/smo/library/">http://www.stsci.edu/institute/smo/library/</a>

## 5. Methodology

Online surveys, investigative and descriptive methods of research are followed for this study. The study followed the web link Analysis which analyzes the various links between the web pages and their relationship. Web Impact Factor has been used as a quantitative tool for evaluating, comparing and ranking the websites.

List of Space Science Research institutions have been determined by referring to Encyclopedia of Astronomy and Astrophysics<sup>10</sup>. Each space science institute website was navigated to find out the availability of library web page or website. Webometric tools such as web crawler software: SocSciBot4 full version (Thelwall, 2009)<sup>11</sup> and Search Engine Optimization (SEO) tools were used for this analysis. The data on Total Number of Web Pages (NWP) and External Links (EL) were obtained using SocSciBot

software. The data on In-Links (IL), Self Links (SL) and Total Links (TL) were obtained by using SEO tools viz., backlinkwatch.com, www.check-domains.com/seo/tools/link-analyzer/ and www.webmaste-toolkit.com/link-extractor.shtml respectively.

## 6. Analysis

The web link analysis, calculation of web impact factor and website ranking has been done on the collected data. The analysis and interpretations are divided into three sections, viz., 1) Web Link Analysis; 2) Web Impact Factors 3) Ranking of Websites.

### 6.1 Web Link Analysis

The web link analysis has been carried out on Space Science Libraries' Websites. For this analysis, the details such as Number of Web Page (NWP), External Links (EL), In Links (IL), Self Links (SL) and Total Links (TL) have been gathered and provided in Table 2.

**Table 2: Web Link Analysis of the Websites of Space Science Libraries**

S.N.	Space Science Library and Country	NWP	EL	IL	SL	TL
1	Indian Institute of Space Science and Technology Library, India	9	847	2569	137	145
2	Indian Institute of Remote Sensing Library, India	2373	205334	2762	129	131
3	INPE - National Institute for Space Research Library, Brazil	1	1	43464	0	0
4	Canadian Space Agency (CSA) Library, Canada	4	151	23040	55	59
5	International Space University Library, France	250	7870	120	30	35
6	Italian Space Agency Library, Italy	81	4734	37173	74	79
7	Institute of Space and Astronautical Science Library, Japan	74	434	767	8	9
8	Institute of Space Technology Library, Pakistan	1	0	861	92	102
9	Space Research Centre Library, Polish Academy of Sciences, Poland	26	2752	11	29	32
10	National Institute of Aerospace Research Library, Romania	1623	22053	638	105	122
11	Space Research Institute Library, Saudi Arabia	2	0	9792	43	53
12	Center for Astrophysics & Space Sciences Library, University of California, USA	30	575	296	35	39

S.N.	Space Science Library and Country	NWP	EL	IL	SL	TL
13	University of Tennessee Space Institute Library, USA	56	1957	6887	39	54
14	National Aeronautics and Space Administration (NASA) Headquarters Library, USA	537	3938	2850	12	14
15	NASA Ames Research Centre Library, USA	67	3709	32	29	54
16	Space Science and Engineering Centre Library, University of Wisconsin-Madison, USA	344	1342	103	17	26
17	Space Telescope Science Institute Library, USA	641	13969	65568	70	86

**NWP** – Number of **Web Pages**; **EL** – **External Links**; **IL** – **In Links**; **SL** – **Self Links**; **TL** – **Total Links**

From the above table, it can be seen that 17 Space Science Libraries Website have Number of Web Pages with a range from 1 page to 2,373 pages, External Links varies from 0 to 2,05,334, In Links from 11 to 65,568, Self Links from 0 to 137 and Total Links from 0 to 145. The data analyzed and computed for Space Science Libraries Website reveals that an average of 27,921 web pages and various links exists, with a total of 4,74,662 together for 17 websites. The results of the data analysis for percentage-wise distribution of web pages and various web links illustrate that NWP has 1.29%, EL 56.81%, IL 41.49% SL 0.19% and TL 0.22%. Therefore, the EL is higher than other links.

After computing all the links for each website, it is found that Indian Institute of Remote Sensing Library, India has highest number of links with 2,08,356 links, followed by Space Telescope Science Institute Library, USA has 2<sup>nd</sup> highest number links with 79,693 links and INPE - National Institute for Space Research Library, Brazil has 3<sup>rd</sup> highest number links with 43,465 links.

Further, when compared on positions of 2 Indian Space Science Libraries, viz., Indian Institute of Remote Sensing Library, Dehradun and Indian Institute of Space Science and Technology Library,

Thiruvanthapuram, they are positioned at 1<sup>st</sup> and 12<sup>th</sup> respectively in total of all web links.

## 6.2 Web Impact Factors (WIFs) and Websites Ranking

Calculating impact factors for web sites, named Web Impact Factors (WIFs). It has similarity with Journal Impact Factor (JIF). There are various types of WIFs, such as Simple WIF, Self-Link WIF, External-Link WIF and Revised WIF. Ranking of websites are determined on the basis of WIFs. These WIFs have been calculated by the following formulas.

- ▶ Simple WIF calculated for each website using the formula  $(B \div A)$ , Total links (B) divided by Number of web pages (A).
- ▶ Self-Link WIF calculated for each website using the formula  $(C \div A)$ , Self-links (C) divided by Number of web pages (A).
- ▶ External Link WIF calculated for each website using the formula  $(D \div A)$ , External link web pages (D) divided by Number of web pages (A).
- ▶ Revised WIF calculated for each website using the formula  $(E \div A)$ , In-links (E) divided by Number of web pages (A).

**Table 3: Web Impact Factors (WIFs) of the Websites of Space Science Libraries**

S. N.	Space Science Library	Simple WIF (SWIF)	Self-Link WIF (SLWIF)	External Link WIF (ELWIF)	Revised WIF (RWIF)
1	Indian Institute of Space Science and Technology Library	16.11	15.22	94.11	285.44
2	Indian Institute of Remote Sensing Library	0.06	0.05	86.53	1.16
3	INPE - National Institute for Space Research Library	0.00	0.00	1.00	43464.00
4	Canadian Space Agency (CSA) Library	14.75	13.75	37.75	5760.00
5	International Space University Library	0.14	0.12	31.48	0.48
6	Italian Space Agency Library	0.98	0.91	58.44	458.93
7	Institute of Space and Astronautical Science Library	0.12	0.11	5.86	10.36
8	Institute of Space Technology Library	102.00	92.00	0.00	861.00
9	Space Research Centre Library, Polish Academy of Sciences	1.23	1.12	105.85	0.42
10	National Institute of Aerospace Research Library	0.08	0.06	13.59	0.39
11	Space Research Institute Library	26.50	21.50	0.00	4896.00
12	Center for Astrophysics & Space Sciences Library, University of California	1.30	1.17	19.17	9.87
13	University of Tennessee Space Institute Library	0.96	0.70	34.95	122.98
14	National Aeronautics and Space Administration (NASA) Headquarters Library	0.03	0.02	7.33	5.31
15	NASA Ames Research Centre Library	0.81	0.43	55.36	0.48
16	Space Science and Engineering Centre Library, University of Wisconsin-Madison	0.08	0.05	3.90	0.30
17	Space Telescope Science Institute Library	0.13	0.11	21.79	102.29

**Table 4: Revised WIF Ranking of the Websites of Space Science Libraries**

Space Science Library and Country	Revised WIF (RWIF)	Ranking by Revised WIF
INPE - National Institute for Space Research Library, Brazil	43464.00	1
Space Research Institute Library, Saudi Arabia	4896.00	2
Canadian Space Agency (CSA) Library, Canada	5760.00	3
Institute of Space Technology Library, Pakistan	861.00	4
Italian Space Agency Library, Italy	458.93	5
Indian Institute of Space Science and Technology Library, India	285.44	6
University of Tennessee Space Institute Library, USA	122.98	7
Space Telescope Science Institute Library, USA	102.29	8
Institute of Space and Astronautical Science Library, Japan	10.36	9
Center for Astrophysics & Space Sciences Library, University of California, USA	9.87	10
National Aeronautics and Space Administration (NASA) Headquarters Library, USA	5.31	11
Indian Institute of Remote Sensing Library, India	1.16	12
International Space University Library, France	0.48	13
NASA Ames Research Centre Library, USA	0.48	
Space Research Centre Library, Polish Academy of Sciences, Poland	0.42	14
National Institute of Aerospace Research Library, Romania	0.39	15
Space Science and Engineering Centre Library, University of Wisconsin-Madison, USA	0.30	16

It can be noted from the above table that INPE - National Institute for Space Research Library, Brazil occupies first position with 43,464 in-links and 1 web page with 43464.00 RWIF. The homepage of INPE - National Institute for Space Research Library, Brazil is shown in screenshot No. 6.1. Two of Space Science

Libraries' Websites holds same ranks like International Space University Library, France and NASA Ames Research Centre Library, USA at 13<sup>th</sup> position with 120 in-links, 250 web pages and 32 in-links, 67 pages correspondingly.



**Screenshot No. 6.1: Homepage of INPE - National Institute for Space Research Library, Brazil**

Further, when compared on positions of 2 Indian Space Science Libraries, viz., Indian Institute of Space Science and Technology Library, Thiruvananthapuram and Indian Institute of Remote Sensing Library, Dehradun, they are positioned at 6<sup>th</sup> and 12<sup>th</sup> respectively in Revised WIF.

## 7. Discussion

The study revealed that 93 Space Science Institute exist in India and other countries. 76 Space Science Institute did not have library website and only 17 libraries' websites were available. Therefore only 18% space science libraries' websites were available and accessible. Though Indian Institute of Remote Sensing Library (IIRSL) website has the highest number of web pages with total of 2,373 pages, highest number of total web links with 2,08,356 links, the positions according to SWIF, SLWIF, ELWIF and RWIF are 14<sup>th</sup>, 13<sup>th</sup>, 3<sup>rd</sup> and 12<sup>th</sup> respectively. Since these WIFs are measured by number of web pages, proportionately the links should be more than the web pages. The analysis evidently showed that 3<sup>rd</sup> position for IIRSL in ELWIF has been achieved due to more number of external links proportionate to NWP. However, according to RWIF, IIRSL ranked

12<sup>th</sup> position due to less number in-links proportionate to NWP. Two of Space Science Library Website viz., National Institute for Space Research Library, Brazil and Institute of Space Technology Library, Pakistan has 1 web page each. They ranked 1<sup>st</sup> and 4<sup>th</sup> as per RWIF with 43,464 and 861 in-links respectively. Therefore, more number of links with less number of web pages the ranking of website will be on top.

## 8. Conclusion

The study reveals that the need for library web site in space research organization / agency to serve the users as only 18% available in the world, which is very low. Library website requires periodic update for changes, additions and redesign as per new technology to serve the users. The library and web site designers can consider two aspects i.e. less number of pages and size of images, so that the library website ranks top among others and convenient for use. Ranking of websites may bring a competitive nature among the libraries to provide better services through their websites.

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