Measuring Citation Diffusion of Selective Indian Physics and Astronomy Journals by Citation Swing Factor (CSF)

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ABSTRACT
The $h$-index, introduced by Hirsch, is based on the mutual variation between the number of cited and source items. The continuous citation accumulation process over time results in diffusion of cited items from the $h$-core zone to the adjacent citation-asymmetric $h$-excess and/or $h$-tail zones. The indicator Citation Swing Factor (CSF) has recently been developed to measure this diffusion process quantitatively on the basis of $h$-core citations, excess citations and total citations. CSF is defined as the ratio of change in FET to change in FHE, where FHE ($Fractional\ H-core\ to\ Excess\ citation$) indicates the ratio of $h$-core citations to excess citations and FET ($Fractional\ Excess\ to\ Total\ citation$) indicates the ratio of excess citations to total citations. The observed or experimental value of CSF as followed from the basic definition, i.e. the ratio of change in FHE to change in FET over consecutive years, results (–$R^2/\ he^2$) that was obtained on the basis of a theoretical calculation, where $R^2$, $h^2$ and $e^2$ indicate total citations, $h$-core citations and excess citations respectively. The later expression indicates the expected or theoretical value of CSF. This paper found observed values of CSF for fifteen esteemed Indian physics journals over the last decade (2010-2019) and compared it with the respective theoretical values. The average error over all journals for ten years is found 2.94% indicating close proximity between theoretically expected and practically observed values. Only one journal, viz. Bulletin of the Astronomical Society of India shows large discrepancy between expected and observed values with an average error of 14.3%.

Keywords: $h$-Index, Excess Citation, e-Index, R Index, Total Citation, Citation Diffusion, Citation Swing Factor, Indian Physics Journal.

INTRODUCTION
The citation analysis is a tool for quantitative studies of science research output. Pinski and Narin¹,² were first who applied citation analysis in a systematic way to assess institutions using a standard methodology. Eugene Garfield³–⁷ illustrated in several articles the potentialities of citation analysis in the evaluation of research faculty. According to Price[,] citation patterns in research articles indicate the research front in a particular subject domain. The citation is a recognition of intellectual works that is reckoned as principal rewards of science.⁸ Other viewpoints recommend that publishing papers is a means of protecting an individual’s intellectual property rights, or it is a way to convince others to accept certain ideas.⁹ The usual citation-based metrics like $h$-index or Eigenfactor have recently been complemented by alternative indicators,¹⁰ mostly due to the rise of the social web and its fast uptake by scholars.¹¹ The accretion of citation by papers, though varies widely across disciplines, yet the diffusion of citation shows the S-curve for cumulative citations in all major science disciplines that is reckoned as a general citation diffusion model introduced by Price.¹²

Citation Swing Factor: An Indicator to Measure Citation Diffusion
The $h$-index of Hirsch is very well-known nowadays. A scientist has $h$-index equal to $H$ if the top $H$ of his/her $N$ publications from a ranked list have at least $H$ citations each.¹³ Besides, there are numbers of indices developed so far known as $h$-type indices.¹⁴ One of the major objectives of $h$-type indices were to normalise $h$-index by dividing number of publications or the age of citation (time normalization). An author or journal once receives one citation enters in the domain of the cited vs. citing graph (Figure 1) through the tail zone that is the entry point. The number of citations received may be increased in due course of time causing the said cited item gradually shifting from the tail zone towards $h$-core zone and $h$-excess zone eventually. Such a movement of a cited item in the cited vs. citing graph (Figure 1) may be termed as...
diffusion of cited item. The indicator Citation Swing Factor (CSF) has recently been developed to measure this diffusion quantitatively,\(^{15}\) which is the ratio of change in FHE \((d\theta)\) to change in FET \((de)\). The parameters FHE and FET indicate the fraction of h-core to excess citations and fraction of excess to total citations respectively and equivalent to the fractional h-core citations over fractional excess citations. The observed or experimental value of CSF that is followed from the basic definition is represented as \((d\theta/de)\). Here both \(\theta\) and \(e\) are continuous variables and consequently, both FHE and FET are also continuous variables. The differentiation of \(\theta\) with respect to \(e\) yielded the value \((-R^2/he^2)\), where \(R^2\), \(h^2\) and \(e^2\) indicate total citations, h-core citations and excess citations respectively.\(^{16,17}\) The indicator CSF thus points out the shift of h-core citations with respect to fold of excess citations to total citations, which in turn, Figures the citation shift from h-core to h-excess zone.

**Aims of the Study**

A new indicator Citation Swing Factor (CSF) has recently been developed\(^{15}\) to measure the diffusion of cited items (authors, journals, institutions etc.) from h-tail zone to h-core zone and subsequently from h-core zone to h-excess zone by continuously receiving citations. It is axiomatic that the citation accretion process is an incessant time-dependent phenomenon, which results a shift of cited items from the h-tail to h-excess zones via the central h-core zone. The h-tail and h-excess zones are asymmetric while the h-core zone is a symmetric zone, as h-tail zone represents large number of low-cited papers whereas the h-excess zone represents small number of high-cited papers. But the h-core zone, a square-shaped symmetric box, represents ‘h’ number of papers received ‘h’ citations. This paper aims to find out observed values of CSF for fifteen esteemed Indian physics and astronomy journals over the last decade (2010–2019) and to compare the same consequently with the respective calculated theoretical values. The main objective of this study is to practically testify the formulation of the new indicator Citation Swing Factor.

**Formulation of the Problem**

The excess citations received by all articles in the h-core zone, which is denoted by \(e^2\) (Figure 1), may be represented as:

\[
e^2 = \sum(C_j - h) = \sum C_j - h^2 \quad (1)\]

Where \(c_j\) are the citations received by the \(j\)-th paper and \(e^2\) denotes the excess citations within the h-core zone. Assuming,

\[
d^2 = \sum C_j \quad (2)
\]

It is obtained, \(d^2 = e^2 + h^2\); \((3)\)

Here \(e \geq 0\) and \(e\) is a real number.

Or

\[
e = \sqrt{(d^2 - h^2)} \quad (4)
\]

The relationship between \(h\) and \(e\), as expressed in equation (3) and equation (4), instantly depicts a plane spanned by two axes, \(h\) and \(e\), or \(h-e\) plane. Now, an arbitrary point in the \(h-e\) plane represents the overall information of citations received by all papers in the h-core. It is interesting to point out that the Euclidean distance between the origin and the point \(P(h,e)\) is equal to

\[
R = \sqrt{(h^2 + e^2)} = d \quad (5)
\]

The X-axis and Y-axis represent a number of publications and citations, respectively. The area under the rectangular hyperbolic curve (Figure 1) represents the total number of citations received, which is segmented into three components. The h-core citation is represented by the shaded square \((h^2)\) area, while the total excess citation is scattered outside the shaded square area, under the curve (Figure 1) separated into two segments by the \(h^2\)-zone, viz. upper h-core zone and lower h-core zone. The upper and lower h-core zones residing adjacent to Y-axis and X-axis, together represent the total number of excess citations or net excess citations over h-core citations. The number of citations in the lower h-core zone is also known as Tail Citation.\(^{16,17}\) Broadly speaking, tail citation also belongs to the category of excess citation, but as it consists of a large number of publications received a low number of citations \((1, 2, 3 ..., )\), therefore the name ‘Tail’ resembling trough of the graph. The citations in the upper h-core zone are also known as an h-core excess citation\(^{16,17}\) that distinguishes it from its ‘Tail’ counterpart.

The h-core citation indicates the cluster of h-h citations vs. papers, which is the result of the accumulation of ‘h’ citations over at least ‘h’ papers. Larger the area of \(h^2\) (Figure 1), the value of \(h\)-index will be proportionately greater. For any fixed total number of citations, the steady increase in the value
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of h-core citations \( (h^2) \) would gradually reduce the excess citation \( (e^2) \). The h-core citations echo the concentration of citations through clustering over ‘h’ number of core values. On the contrary, the excess citations portray the scattering of citations outside the h-core or \( h^2 \) domain. The relative share of h-core citation and excess citation in the corpus of total citation depicts the relative centralization and scattering phenomenon of citation over time.

Now,

\[
e^2 = \frac{e^2}{R^2} = \frac{\text{Excess Citation}}{\text{Total Citation}} = \frac{\text{Excess Citation}}{\text{(h-core citation + excess citation)}}
\]

so that,

\[
e = \frac{e}{\sqrt{R^2 + e^2}} = \frac{e}{\sqrt{e^2(1 + \frac{h^2}{e^2})}} = \left(1 + \frac{h^2}{e^2}\right)^{-\frac{1}{2}}
\]

Also, \( \theta^2 = \frac{h^2}{e^2} \), so, \( \theta = \frac{h}{e} \) ... (7) and substituting in equation (6)

It is obtained, \( \varepsilon = (1 + \theta^2)^{-\frac{1}{2}} \) ... (8) (Only positive roots are considered here)

If h-core citation \(< e\text{Excess citation, i.e. } \theta < 1\), which may occur for relatively small h-core citation or \( h \)-index and high excess citation or e-index, then

\[
e = 1 - \frac{\theta^2}{2} + \frac{\theta^4}{8} - \frac{\theta^6}{16} + ... \approx 1 - \frac{\theta^2}{2} \quad ... (8A)
\]

(obtained from equation (8) by applying Maclaurin’s expansion theorem and neglecting small quantities of higher order), or \( \theta = \sqrt{2(1 - \varepsilon)} \) ... (9) (Taking positive root only)

Differentiating both sides of equation (9) with respect to \( \varepsilon \), it is obtained

\[
\frac{d\theta}{d\varepsilon} = \text{Citation Swing Factor (CSF)} = -\frac{1}{\theta^2\varepsilon^3} = -\frac{R^2}{h^2e^2} \quad ... (10)
\]

The \( \frac{d\theta}{d\varepsilon} \) is represented by CSF(Expected) or CSF(E), while \( \left( -\frac{R^3}{h^2e^2} \right) \) is represented by CSF(Observed) or CSF(O). The observed values are calculated directly from the available data for the fifteen journals (Table) while the expected values are calculated on the basis of the derived formula \( \left( -\frac{R^3}{h^2e^2} \right) \) (Equation (10)).

Hypothesis Formulated

The following ten null hypotheses \( (H_0) \) grouped into four categories have been formulated for this study. The first and second categories including two null hypotheses each state the constancy of FET and FHE respectively both for eleven consecutive years (2009-2019) and twelve journals respectively. The third category including four null hypotheses state the constancies of CSF(O) and CSF(E) both for eleven consecutive years (2009-2019) and twelve journals. The fourth category including two null hypotheses has stated the equalities between CSF(O) and CSF(E) both for eleven consecutive years (2009-2019) and twelve journals.

It is to be noted that, although the numerical values of FET, FHE, CSF(O) and CSF(E) presented in Table 1 to Table 4 include fifteen journals, but the following ten null hypotheses are tested for twelve journals only. As the Scopus has not indexed the 2018-19 data for Indian Journal of Radio and Space Physics and the 2010-14 data for Journal of Vibrational Engineering and Technologies, and also the journal entitled Bulletin of the Astronomical Society of India, was discontinued on and from 2015, therefore the data for these three journals are not fully comprehensive over the stipulated time span. The testing of hypotheses has been executed by ANOVA (F-Test) method and T-test method, which are presented in Table 5 and Table 6. The Hypothesis No. 4 is tested by T-test for the sample mean. The results of the testing of hypotheses for the eleven consecutive years from 2009 to 2019 are presented in Table 5, while the same for the twelve said journals are presented in Table 6.

Hypothesis 1

\( H_1(1.1) \): The e-index bears a constant ratio with R-Index, i.e. FET \( (\varepsilon) \) remains constant for eleven years (2009-19)

\( H_1(1.2) \): The e-index bears a constant ratio with R-Index, i.e. FET \( (\varepsilon) \) remains constant for twelve physics and astronomy journals considered for this study

Hypothesis 2

\( H_2(2.1) \): The \( h \)-index bears a constant ratio with e-Index, i.e. FHE \( (\theta) \) remains constant for eleven years (2009-19)

\( H_2(2.2) \): The \( h \)-index bears a constant ratio with e-Index, i.e. FHE \( (\theta) \) remains constant for twelve physics and astronomy journals considered for this study

Hypothesis 3

\( H_3(3.1) \): The numerical values of CSF (O) are constant for the twelve physics and astronomy journals

\( H_3(3.2) \): The numerical values of CSF (O) are constant for the ten consecutive years (2010-2019)
Hypothesis 4

H. (3.3): The numerical values of CSF (E) are constant for the twelve physics and astronomy journals

H. (3.4): The numerical values of CSF (E) are constant for the ten consecutive years (2010-2019)

Hypothesis 4

H. (4.1): The numerical values of CSF (O) for twelve physics and astronomy journals are equal to the numerical values of CSF(E) for the same

H. (4.2): The numerical values of CSF (O) for ten consecutive years (2010-2019) are equal to the numerical values of CSF(E) for the same.

SCOPE AND METHODOLOGY

This paper has found out the observed numerical values of Citation Swing Factor or (dθ/dε) (as deduced in equation (10)) for fifteen esteemed Indian physics journals over the last decade (2010-2019) and compared it with the respective theoretical numerical values or -R^2/h^e^2. Of the fifteen journals, eight journals belong to core domain of physics and astronomy (S. No. 1, 3, 5, 6, 7, 8, 10 and 13), while five journals belong to allied interdisciplinary areas of physics but publish articles on physics regularly (S. No. 2, 4, 9, 11 and 12). The last two journals belong to entire natural science discipline but publish physics articles on regular basis. These two journals are very old and esteemed Indian science journals.

The number of papers published in each journal from 2009 to 2019 along with total citations, h-core citations and excess citations are noted down at first. The number of published papers along with the corresponding number of citations received for each of the fifteen said journals for all the consecutive years from 2009 to 2019 have been collected from Scopus database. On the basis of these data, the h-core and excess citations are calculated to find out FET and FHE. The annual changes in the values of FHE and FET yielded dθ and de respectively. The ratio of dθ to de or dθ/de gives the observed value of CSF, which is compared with the theoretical value, i.e. -R^2/h^e^2, where R^2, h^2 and e^2 indicate total citations, h-core citations and h-core excess citations respectively. The titles of the physics and astronomy journals published from India selected for this study is furnished below with the respective abbreviations given in the adjacent parenthesis.

1. Bulletin of the Astronomical Society of India (BASI)
2. Defence Science Journal (DSJ)
3. Indian Journal of Biochemistry and Biophysics (IJBB)
4. Indian Journal of Engineering and Materials Sciences (IJEMS)
5. Indian Journal of Physics (IJP)
6. Indian Journal of Pure and Applied Physics (IJPAP)
7. Indian Journal of Radio and Space Physics (IJRSP)
8. Journal of Astrophysics and Astronomy (JAA)
9. Journal of Earth System Science (JESS)
10. Journal of Medical Physics (JMP)
11. Journal of Scientific and Industrial Research (JSIR)
12. Journal of Vibrational Engineering and Technologies (JVET)
13. Pramana - Journal of Physics (PJP)
14. Proceedings of the Indian National Science Academy (PINSA)
15. Proceedings of the National Academy of Sciences India Section A - Physical Sciences (PNASI)

RESULTS AND ANALYSIS

The numerical data representing both temporal variations and journal-wise variations of FET, FHE, CSF(O), CSF(E) and Percentage Errors of fifteen journals are presented in Table 1, 2, 3, 4 and 7 respectively and the variational patterns of FET, FHE, CSF(O), CSF(E) and Percentage Errors for fifteen said journals are graphically presented in Figures 2, 3, 4, 5 and 6 respectively. The values of FET, FHE and CSF are calculated from total citations, h-core citations and h-core excess citations of fifteen journals. The numerical Figures of FET, FHE, CSF(O), CSF(E) and Percentage Errors for the individual journals are presented in Table 8 to Table 22 (Appendix).

The overall average values of FET and FHE for fifteen journals are 0.86 and 0.59 with average standard deviations 0.05 and 0.13 respectively. Also, the overall average values of FET and FHE for eleven consecutive years from 2009 to 2019 are 0.86 and 0.59 with average standard deviations 0.04 and 0.12 respectively. The overall average values of CSF(O) and CSF(E) for fifteen journals are 2.72 and 2.77 with average standard deviations 0.12 and 0.21 respectively. Again, the overall average values of CSF(O) and CSF(E) for eleven consecutive years from 2009 to 2019 are 2.71 and 2.75 with average standard deviations 0.05 and 0.13 respectively. Also, the overall average values of FET, FHE, CSF(O), CSF(E) and Percentage Errors for the individual journals are presented in Table 8 to Table 22 (Appendix).

The value of FET ranges from 0.7 to 1 indicating proximal Figures of excess citation with respect to total citation. The value of FHE ranges from 0.1 to 1, which indicates the fraction of h-core citation with respect to excess citation widely varies compared to the variation of excess citation with respect to total citation. Both of the observed and expected values of Citation Swing Factor (CSF) range from 2.5 to 3 indicating...
near-constancy of CSF for the fifteen stipulated Indian physics and astronomy journals over the last decade (2010–’19). The close proximity of observed and expected values of CSF as signalled by low percentage error (2.74%) has established the theoretical background of the indicator CSF. It is interesting to note that, only one journal viz. Bulletin of the Astronomical Society of India, shows discrepancy in the values of FET, FHE and CSF. The high asymmetric citation pattern of this journal, i.e. very few articles received extremely large number of citations with large number of articles leaving uncited, which may be the reason behind this aberration. The percentage error for this journal is also highest, i.e. 14.4% indicating broad variations of CSF values over the years along with the remoteness between theoretical and practically observed CSF values. Besides, other 14 journals show consistent values of FET, FHE and CSF.

It is observed from Table 5 and Table 6, of the ten null hypothesis formulated in total, four null hypotheses $[H_{0}(1.2),}$
### Table 3: Variations of CSF(O) [The magnitude is taken only].

| Journal | BASI | DSJ | IJBB | JEMS | JIP | UPAP | URSP | JAA | JESS | JMP | JSIR | JVET | PINSA | PJP | PNASI |
|---------|------|-----|------|------|-----|------|------|-----|------|-----|------|------|-------|-----|-------|
| Year    |      |     |      |      |     |      |      |     |      |     |      |      |       |     |       |
| 2010    | 3.18 | 2.66| 2.60 | 2.61| 2.71| 2.67 | 2.64 | 2.64| 2.62 | 2.74 | 2.70 | 2.66 | 2.71 | 2.64 |
| 2011    | 2.66 | 2.61| 2.61| 2.60| 2.67| 2.66 | 2.62 | 2.65| 2.63 | 2.70 | 2.68 | 2.74 | 2.68 | 2.61 |
| 2012    | 2.69 | 2.61| 2.62| 2.61| 2.73| 2.64 | 2.60 | 2.60| 2.61 | 2.64 | 2.63 | 2.63 | 2.63 | 2.61 |
| 2013    | 2.92 | 2.60| 2.61| 2.61| 2.82| 2.64 | 2.60 | 2.60| 2.64 | 2.67 | 2.68 | 2.61 | 2.63 | 2.76 |
| 2014    | 4.60 | 2.61| 2.61| 2.64| 2.83| 2.65 | 2.60| 2.67| 2.75 | 2.60| 2.79 | 2.61 | 2.81 | 2.68 |
| 2015    | 2.62 | 2.73| 2.61| 2.74| 2.67 | 2.61 | 2.69 | 2.73| 2.60| 2.85 | 2.66 | 2.62 | 2.95 | 2.61 |
| 2016    | 2.62 | 2.78| 2.60| 2.69 | 2.73 | 2.66 | 2.67| 2.71| 2.61 | 2.79 | 2.73 | 2.64 | 2.89 | 2.62 |
| 2017    | 2.66 | 2.66| 2.66| 2.67 | 2.71 | 2.62 | 2.74 | 2.65| 2.65 | 2.75 | 2.66 | 2.86 | 2.63 | 2.63 |
| 2018    | 2.74 | 2.67| 2.71| 2.69 | 2.71 | 2.62 | 2.85 | 2.64| 2.65 | 2.76 | 2.80 | 2.68 | 2.68 | 2.68 |
| 2019    | 2.75 | 2.83| 2.66| 2.83 | 2.93 | 2.66 | 3.27 | 2.83| 2.70 | 2.69 | 2.90 | 2.80 | 2.86 | 2.86 |
| Mean    | 3.21 | 2.65| 2.67| 2.63| 2.74 | 2.70 | 2.62 | 2.64| 2.75 | 2.67| 2.71 | 2.70 | 2.68 | 2.78 |
| Standard Deviation | 0.81 | 0.06 | 0.08 | 0.04 | 0.07 | 0.09 | 0.02 | 0.03 | 0.20 | 0.07 | 0.07 | 0.04 | 0.09 | 0.11 |

### Table 4: Variations of CSF(E) [The magnitude is taken only].

| Journal | BASI | DSJ | IJBB | JEMS | JIP | UPAP | URSP | JAA | JESS | JMP | JSIR | JVET | PINSA | PJP | PNASI |
|---------|------|-----|------|------|-----|------|------|-----|------|-----|------|------|-------|-----|-------|
| Year    |      |     |      |      |     |      |      |     |      |     |      |      |       |     |       |
| 2010    | 2.70 | 2.60| 2.60| 2.60| 2.68| 2.67 | 2.69 | 2.76| 2.65 | 2.97| 2.72 | 2.77 | 2.71 | 2.61 |
| 2011    | 2.88 | 2.61| 2.63| 2.60| 2.66| 2.65 | 2.62 | 2.60| 2.61 | 2.60| 2.65 | 2.71 | 2.64 | 2.65 |
| 2012    | 2.60 | 2.61| 2.62| 2.63| 2.82| 2.63 | 2.60| 2.61| 2.61 | 2.75| 2.61 | 2.60 | 2.63 | 2.62 |
| 2013    | 3.97 | 2.60| 2.60| 2.66| 2.81| 2.65 | 2.60| 2.62| 2.69 | 2.62| 2.79 | 2.64 | 2.64 | 3.01 |
| 2014    | 5.55 | 2.63| 2.63| 2.63| 2.85| 2.64 | 2.60| 2.73| 2.82 | 2.61| 2.80 | 2.60 | 3.11 | 2.65 |
| 2015    | 2.61 | 2.88| 2.60| 2.66| 2.71| 2.63 | 2.66| 2.67| 2.67 | 2.62| 2.92 | 2.64 | 2.63 | 2.62 |
| 2016    | 2.63 | 2.71| 2.60| 2.72| 2.77| 2.83 | 2.68| 2.76| 2.61 | 2.69| 2.86 | 2.65 | 2.98 | 2.62 |
| 2017    | 2.69 | 2.63| 2.79| 2.63| 2.66| 2.61 | 2.73| 2.72| 2.78 | 2.67| 2.67 | 2.77 | 2.63 | 2.63 |
| 2018    | 2.79 | 2.72| 2.65| 2.77| 2.76 | 2.71| 3.02 | 2.60| 2.65 | 2.63 | 2.89 | 2.82 | 2.75 | 2.63 |
| 2019    | 2.72 | 2.97| 2.67| 2.89| 3.17 | 2.62| 3.60 | 3.51 | 2.76| 2.78 | 2.90| 2.78 | 3.00 | 2.86 |
| Mean    | 3.54 | 2.65| 2.70| 2.64| 2.75| 2.73 | 2.65| 2.66| 2.81 | 2.76| 2.74 | 2.72 | 2.71 | 2.79 |
| Standard Deviation | 1.25 | 0.06 | 0.13 | 0.06 | 0.09 | 0.16 | 0.08 | 0.06 | 0.30 | 0.29 | 0.09 | 0.10 | 0.11 | 0.16 |

$H_0(2.2), H_0(3.3)$ and $H_0(4.2)$] are accepted at 1% level of significance. Only the null hypothesis $H_0(3.3)$ is accepted at 5% level of significance also. Other null hypotheses are rejected at both 5% and 1% levels of significance. The correlation analysis between CSF(O) and CSF(E) yielded the values of the Correlation Coefficients ($r_{xy}$) as 0.967 (for yearwise study) and 0.88 (for journalwise study), which indicates strong positive correlation between the numerical values of CSF(O) and CSF(E). Since $H_0(1.2)$ is accepted, the $e$-index bears a constant ratio with $R$-index for twelve journals (excluding BASI, IJRSP and JVET). Also, $h$-index bears a constant ratio with $e$-index for the same sample, as $H_0(2.2)$ is accepted. The numerical values of CSF(E) for the same sample are equal, as $H_0(3.3)$ is accepted. The acceptance of $H_0(4.2)$ and the strong positive correlation coefficients has established the validity of the Equation (10), i.e. the accuracy of the theoretical background of the concept of Citation Swing Factor is proved here.
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5.29
0.025 (at 2.5% level of significance)
Inference: Null

0.01 (at 1% level of significance)

2.399
1.869

2.308
0.0232

Whether CSF(O) = or ≈ CSF(E) ?
(tested by T-Test and Correlation Analysis respectively)

Pearson’s Product-Moment Correlation Coefficient between CSF(O) and CSF(E) (r

310

3.523
0.00041

Table 5: Testing of hypothesis for population means of FET, FHE, CSF(O) and CSF(E) for the eleven consecutive years from 2009 to 2019.

| Indicators | F_0 / t_0 | Value of P | F_c / t_c | α (Level of Significance) | Observation | Inference: Null Hypothesis (H_0) is |
|------------|-----------|------------|-----------|---------------------------|-------------|-----------------------------------|
| FET        | 3.474     | 0.00048    | 1.909     | 0.05 (at 5% level of significance) | F_c < F_0; P < α | H_0(1.1) is Rejected |
| FET        | 3.523     | 0.00041    | 1.909     | 0.05 (at 5% level of significance) | F_c < F_0; P < α | H_0(2.1) is Rejected |
| CSF(O)     | 5.29      | 0.00005    | 1.966     | 0.05 (at 5% level of significance) | F_c < F_0; P < α | H_0(3.2) is Rejected |
| CSF(E)     | 5.357     | 0.00005    | 1.966     | 0.05 (at 5% level of significance) | F_c < F_0; P < α | H_0(3.4) is Rejected |

Whether CSF(O) = or ≈ CSF(E) ?
(tested by T-Test and Correlation Analysis respectively)

Pearson’s Product-Moment Correlation Coefficient between CSF(O) and CSF(E) (r

Table 6: Testing of hypothesis for population means of FET, FHE, CSF(O) and CSF(E) for the twelve journals.

| Indicators | F_0 | Value of P | F_c | α (Level of Significance) | Observation | Inference: Null Hypothesis (H_0) is |
|------------|-----|------------|-----|---------------------------|-------------|-----------------------------------|
| FET        | 1.892 | 0.0468    | 1.869 | 0.05 (at 5% level of significance) | F_c < F_0; P < α | H_0(1.2) is Rejected |
| FET        | 1.892 | 0.0468    | 2.399 | 0.01 (at 1% level of significance) | F_c > F_0; P > α | H_0(1.2) is Accepted |
| FHE        | 1.877 | 0.0489    | 1.869 | 0.05 (at 5% level of significance) | F_c < F_0; P < α | H_0(2.2) is Rejected |
| FHE        | 1.877 | 0.0489    | 2.399 | 0.01 (at 1% level of significance) | F_c > F_0; P > α | H_0(2.2) is Accepted |
| CSF(O)     | 2.547 | 0.0067    | 1.878 | 0.05 (at 5% level of significance) | F_c < F_0; P < α | H_0(3.1) is Rejected |
| CSF(E)     | 1.514 | 0.328     | 1.878 | 0.05 (at 5% level of significance) | F_c > F_0; P > α | H_0(3.3) is Accepted |
| CSF(E)     |        |           | 2.416 | 0.01 (at 1% level of significance) |          |                                    |
| Whether CSF(O) = or ≈ CSF(E) ?
(tested by T-Test and Correlation Analysis respectively)

Pearson’s Product-Moment Correlation Coefficient between CSF(O) and CSF(E) (r

F_c / t_c - F_c critical / t_c critical; α - Level of Significance Value; F_c / t_c - F_c observed / t_c observed; P - P-Value; H_0 - Null Hypothesis; df(bg) - Degrees of Freedom (Between groups) = 11; df(wg) - Degrees of Freedom (Within groups) = 120

F_c / t_c - F_c critical / t_c critical; α - Level of Significance Value; F_c / t_c - F_c observed / t_c observed; P - P-Value; H_0 - Null Hypothesis; df(bg) - Degrees of Freedom (Between groups) = 11; df(wg) - Degrees of Freedom (Within groups) = 120

Figure 2: Temporal Variation of FET (ε) for fifteen journals.

Figure 3: Temporal Variation of FHE (θ) for fifteen journals.
CONCLUSION

There are some significant findings have been observed in this study. For instance, the $h$-index bears an almost constant ratio with $e$-index and consequently, the $e$-index bears a nearly constant ratio with $R$-index for twelve journals (excluding BASI, IJRSP and JVET). That is to say, $\frac{h}{e} \approx e \approx R$, or $e$-index is almost equal or of the same numerical order to the geometric mean of $h$-index and $R$-index. The near-equality of CSF(E) for twelve journals indicates the almost identical citation accumulation pattern of the concerned journals.
In this paper, the values of a new indicator viz. Citation Swing Factor (CSF) are calculated for fifteen selected Indian physics and astronomy journals. The close proximity between practically observed and theoretically expected values justifies the theoretical background of the concept of CSF. It is found that CSF remains nearly constant for all journals with very little variation. Now, whether it may be considered as a parameter for the journals will depend on the results of further studies with other core journals from other subject domains. This study may also be extended for authors. Further studies are also required to testify whether CSF remains constant for a subject over a stipulated time period, or varies for different subjects.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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APPENDIX

Table 8: Bulletin of the Astronomical Society of India.

|        | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|--------|------|------|------|------|------|------|
| No. of papers | 7 | 14 | 31 | 34 | 17 | 11 |
| Total citation (TC) | 397 | 56 | 561 | 309 | 216 | 258 |
| H-core citation (HC) | 4 | 25 | 100 | 100 | 16 | 9 |
| Net excess citation (EC) | 393 | 31 | 461 | 209 | 200 | 249 |
| ε=Sqrt(EC/TC) (FET) | 0.995 | 0.744 | 0.907 | 0.822 | 0.962 | 0.982 |
| θ=Sqrt(HC/EC) (FHE) | 0.101 | 0.898 | 0.466 | 0.692 | 0.283 | 0.190 |
| dθ | -0.251 | 0.162 | -0.084 | 0.140 | 0.020 |
| dθ | 0.797 | -0.432 | 0.226 | -0.409 | -0.093 |
| CSF = dθ/dε (Observed Value) | -3.177 | -2.661 | -2.687 | -2.924 | -4.601 |
| CSF = -R^3/(h*e^2) (Expected Value) | -2.704 | -2.882 | -2.599 | -3.968 | -5.548 |
| % Error | 17.500 | 7.695 | 3.407 | 26.312 | 17.062 |
Table 9: Defence Science Journal.

|  | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| No. of papers | 64 | 50 | 63 | 52 | 72 | 62 | 54 | 74 | 83 | 67 | 74 |
| Total citation (TC) | 818 | 539 | 485 | 396 | 368 | 365 | 218 | 362 | 207 | 178 | 71 |
| H-core citation (HC) | 169 | 169 | 144 | 121 | 121 | 100 | 64 | 100 | 49 | 36 | 16 |
| Net excess citation (EC) | 649 | 370 | 341 | 275 | 247 | 265 | 154 | 262 | 158 | 142 | 55 |
| ε = Sqrt(EC/TC) (FET) | 0.891 | 0.829 | 0.839 | 0.833 | 0.819 | 0.852 | 0.840 | 0.851 | 0.874 | 0.893 | 0.880 |
| θ = Sqrt(HC/EC) (FHE) | 0.510 | 0.676 | 0.650 | 0.663 | 0.700 | 0.614 | 0.645 | 0.618 | 0.557 | 0.504 | 0.539 |
| dθ | -0.062 | 0.010 | -0.005 | -0.014 | 0.033 | -0.012 | 0.010 | 0.023 | 0.020 | -0.013 |
| dθ | 0.166 | -0.026 | 0.013 | 0.037 | -0.086 | 0.030 | -0.027 | -0.061 | -0.053 | 0.036 |
| CSF = dθ/dε (Observed Value) | -2.661 | -2.605 | -2.608 | -2.601 | -2.610 | -2.621 | -2.620 | -2.657 | -2.736 | -2.752 |
| CSF = -R^3/(h*e^2) (Expected Value) | -2.602 | -2.610 | -2.605 | -2.598 | -2.631 | -2.629 | -2.693 | -2.787 | -2.719 |
| % Error | 2.297 | 0.183 | 0.094 | 0.098 | 0.824 | 0.333 | 0.330 | 1.319 | 1.830 | 1.185 |

Table 10: Indian Journal of Biochemistry and Biophysics.

|  | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| No. of papers | 72 | 58 | 59 | 61 | 74 | 71 | 43 | 24 | 32 | 50 | 60 |
| Total citation (TC) | 1291 | 908 | 719 | 585 | 697 | 443 | 139 | 39 | 58 | 111 | 99 |
| H-core citation (HC) | 400 | 289 | 196 | 169 | 225 | 121 | 25 | 9 | 16 | 25 | 16 |
| Net excess citation (EC) | 891 | 619 | 523 | 416 | 472 | 322 | 114 | 30 | 42 | 86 | 83 |
| ε = Sqrt(EC/TC) (FET) | 0.831 | 0.826 | 0.853 | 0.843 | 0.823 | 0.853 | 0.906 | 0.877 | 0.851 | 0.880 | 0.916 |
| θ = Sqrt(HC/EC) (FHE) | 0.670 | 0.683 | 0.612 | 0.637 | 0.690 | 0.613 | 0.468 | 0.548 | 0.617 | 0.539 | 0.439 |
| dθ | -0.005 | 0.027 | -0.010 | -0.020 | 0.030 | 0.053 | -0.029 | -0.026 | 0.029 | 0.035 |
| dθ | 0.013 | -0.071 | 0.025 | 0.053 | -0.077 | -0.145 | 0.079 | 0.069 | -0.078 | -0.100 |
| CSF = dθ/dε (Observed Value) | -2.601 | -2.613 | -2.624 | -2.606 | -2.611 | -2.728 | -2.781 | -2.663 | -2.668 | -2.826 |
| CSF = -R^3/(h*e^2) (Expected Value) | -2.600 | -2.633 | -2.616 | -2.599 | -2.632 | -2.875 | -2.706 | -2.629 | -2.720 | -2.967 |
| % Error | 0.052 | 0.765 | 0.300 | 0.260 | 0.796 | 5.130 | 2.771 | 1.283 | 1.886 | 4.743 |

Table 11: Indian Journal of Engineering and Materials Sciences.

|  | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| No. of papers | 67 | 63 | 53 | 44 | 71 | 88 | 82 | 47 | 60 | 59 | 42 |
| Total citation (TC) | 439 | 676 | 560 | 368 | 562 | 445 | 342 | 195 | 124 | 61 | 16 |
| H-core citation (HC) | 121 | 225 | 196 | 144 | 144 | 121 | 121 | 64 | 25 | 16 | 4 |
| Net excess citation (EC) | 318 | 451 | 364 | 224 | 418 | 324 | 221 | 131 | 99 | 45 | 12 |
| ε = Sqrt(EC/TC) (FET) | 0.851 | 0.817 | 0.806 | 0.780 | 0.862 | 0.853 | 0.804 | 0.820 | 0.894 | 0.859 | 0.866 |
| θ = Sqrt(HC/EC) (FHE) | 0.617 | 0.706 | 0.734 | 0.802 | 0.587 | 0.611 | 0.740 | 0.699 | 0.503 | 0.596 | 0.577 |
| dθ | -0.034 | -0.011 | -0.026 | 0.082 | -0.009 | -0.049 | 0.016 | 0.074 | -0.035 | 0.007 |
| dθ | 0.089 | 0.027 | 0.068 | -0.215 | 0.024 | 0.129 | -0.041 | -0.196 | 0.094 | -0.019 |
| CSF = dθ/dε (Observed Value) | -2.608 | -2.599 | -2.611 | -2.613 | -2.644 | -2.607 | -2.599 | -2.658 | -2.708 | -2.656 |
| CSF = -R^3/(h*e^2) (Expected Value) | -2.598 | -2.600 | -2.626 | -2.656 | -2.634 | -2.602 | -2.598 | -2.790 | -2.647 | -2.667 |
| % Error | 0.394 | 0.062 | 0.577 | 1.637 | 0.401 | 0.204 | 0.029 | 4.698 | 2.306 | 0.385 |
### Table 12: Indian Journal of Physics.

|                | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|
| No. of papers  | 160  | 181  | 204  | 169  | 189  | 190  | 154  | 171  | 183  | 172  | 254  |
| Total citation (TC) | 920  | 1178 | 1146 | 1167 | 1484 | 1219 | 670  | 750  | 706  | 584  | 364  |
| H-core citation (HC) | 196  | 289  | 289  | 225  | 289  | 225  | 169  | 169  | 196  | 121  | 64   |
| Net excess citation (EC) | 724  | 889  | 857  | 942  | 1195 | 994  | 501  | 581  | 510  | 463  | 300  |
| $\varepsilon = \sqrt{EC/TC}$ (FET) | 0.887 | 0.869 | 0.865 | 0.898 | 0.897 | 0.903 | 0.865 | 0.880 | 0.850 | 0.890 | 0.908 |
| $\theta = \sqrt{HC/EC}$ (FHE) | 0.520 | 0.570 | 0.581 | 0.489 | 0.492 | 0.476 | 0.581 | 0.539 | 0.620 | 0.511 | 0.462 |
| $\frac{d\theta}{d\varepsilon}$ | -0.018 | -0.004 | 0.034 | -0.001 | 0.006 | -0.038 | 0.015 | -0.030 | 0.040 | 0.017 |
| $\frac{d\theta}{d\varepsilon}$ | 0.050 | 0.011 | -0.092 | 0.003 | -0.016 | 0.105 | -0.041 | 0.081 | -0.109 | -0.049 |
| CSF = $\frac{d\theta}{d\varepsilon}$ (Observed Value) | -2.711 | -2.669 | -2.731 | -2.818 | -2.834 | -2.744 | -2.689 | -2.667 | -2.686 | -2.828 |
| CSF = $-\frac{R^3}{(h^*e^*2)}$ (Expected Value) | -2.675 | -2.663 | -2.821 | -2.814 | -2.854 | -2.663 | -2.719 | -2.627 | -2.771 | -2.894 |
| % Error | 1.343 | 0.229 | 3.193 | 0.130 | 0.724 | 3.049 | 1.111 | 1.507 | 3.053 | 2.262 |

### Table 13: Indian Journal of Pure and Applied Physics.

|                | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|----------------|------|------|------|------|------|------|------|------|------|------|------|
| No. of papers  | 138  | 142  | 121  | 150  | 124  | 97   | 105  | 102  | 99   | 86   | 111  |
| Total citation (TC) | 1150 | 1605 | 989  | 917  | 755  | 546  | 433  | 388  | 255  | 171  | 68   |
| H-core citation (HC) | 289  | 400  | 256  | 256  | 196  | 144  | 100  | 81   | 64   | 36   | 9    |
| Net excess citation (EC) | 861  | 1205 | 733  | 661  | 559  | 402  | 333  | 307  | 191  | 135  | 59   |
| $\varepsilon = \sqrt{EC/TC}$ (FET) | 0.865 | 0.866 | 0.861 | 0.849 | 0.860 | 0.858 | 0.877 | 0.890 | 0.865 | 0.889 | 0.931 |
| $\theta = \sqrt{HC/EC}$ (FHE) | 0.579 | 0.576 | 0.591 | 0.622 | 0.592 | 0.599 | 0.548 | 0.514 | 0.579 | 0.516 | 0.391 |
| $\frac{d\theta}{d\varepsilon}$ | 0.001 | -0.006 | -0.012 | -0.011 | -0.002 | 0.019 | 0.013 | 0.024 | 0.023 | 0.043 |
| $\frac{d\theta}{d\varepsilon}$ | -0.003 | 0.015 | 0.031 | -0.030 | 0.006 | -0.051 | -0.034 | 0.065 | -0.062 | -0.126 |
| CSF = $\frac{d\theta}{d\varepsilon}$ (Observed Value) | -2.666 | -2.660 | -2.638 | -2.637 | -2.648 | -2.673 | -2.734 | -2.710 | -2.708 | -2.930 |
| CSF = $-\frac{R^3}{(h^*e^*2)}$ (Expected Value) | -2.668 | -2.652 | -2.626 | -2.651 | -2.645 | -2.706 | -2.766 | -2.665 | -2.761 | -3.168 |
| % Error | 0.070 | 0.295 | 0.470 | 0.505 | 0.114 | 1.224 | 1.146 | 1.708 | 1.900 | 7.528 |

### Table 14: Indian Journal of Radio and Space Physics.

|                | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|----------------|------|------|------|------|------|------|------|------|------|
| No. of papers  | 42   | 50   | 40   | 58   | 46   | 34   | 22   | 14   | 10   |
| Total citation (TC) | 216  | 206  | 317  | 376  | 151  | 111  | 59   | 18   | 8    |
| H-core citation (HC) | 64   | 49   | 121  | 121  | 49   | 36   | 16   | 9    | 4    |
| Net excess citation (EC) | 152  | 157  | 196  | 255  | 102  | 75   | 43   | 9    | 4    |
| $\varepsilon = \sqrt{EC/TC}$ (FET) | 0.839 | 0.873 | 0.786 | 0.824 | 0.822 | 0.822 | 0.854 | 0.707 | 0.707 |
| $\theta = \sqrt{HC/EC}$ (FHE) | 0.649 | 0.559 | 0.786 | 0.689 | 0.693 | 0.693 | 0.610 | 1.000 | 1.000 |
| $\frac{d\theta}{d\varepsilon}$ | 0.034 | -0.087 | 0.037 | -0.002 | 0.000 | 0.032 | -0.147 | 0.000 |
| $\frac{d\theta}{d\varepsilon}$ | -0.090 | 0.227 | -0.097 | 0.004 | 0.000 | -0.083 | 0.390 | 0.000 |
| CSF = $\frac{d\theta}{d\varepsilon}$ (Observed Value) | -2.643 | -2.619 | -2.604 | -2.599 | -2.599 | -2.612 | -2.660 |
| CSF = $-\frac{R^3}{(h^*e^*2)}$ (Expected Value) | -2.690 | -2.618 | -2.599 | -2.599 | -2.598 | -2.635 | -2.828 |
| % Error | 1.748 | 0.055 | 0.167 | 0.009 | 0.001 | 0.869 | 5.942 |
### Table 15: Journal of Astronomy and Astrophysics.

|   | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|------|------|------|------|------|------|------|------|------|------|------|
| No. of papers | 14   | 17   | 116  | 19   | 30   | 118  | 47   | 42   | 72   | 75   | 50   |
| Total citation (TC) | 79   | 43   | 431  | 67   | 175  | 162  | 195  | 102  | 331  | 109  | 56   |
| H-core citation (HC) | 36   | 9    | 144  | 25   | 49   | 36   | 49   | 25   | 121  | 25   | 16   |
| Net excess citation (EC) | 43   | 34   | 287  | 42   | 126  | 126  | 146  | 77   | 210  | 84   | 40   |
| $\epsilon$ | 0.738 | 0.889 | 0.816 | 0.792 | 0.849 | 0.882 | 0.865 | 0.869 | 0.797 | 0.878 | 0.845 |
| $\theta$ | 0.915 | 0.514 | 0.708 | 0.772 | 0.624 | 0.535 | 0.579 | 0.570 | 0.759 | 0.546 | 0.632 |
| $d\epsilon$ | 0.151 | -0.073 | -0.024 | 0.057 | 0.033 | -0.017 | 0.004 | -0.072 | 0.081 | -0.033 |
| $d\theta$ | -0.400 | 0.194 | 0.063 | -0.148 | -0.089 | 0.045 | -0.010 | 0.189 | -0.214 | 0.087 |
| CSF = $d\theta/d\epsilon$ (Observed Value) | -2.645 | -2.649 | -2.603 | -2.605 | -2.668 | -2.694 | -2.670 | -2.617 | -2.625 | -2.657 |
| CSF = $-R^3/(h*e^2)$ (Expected Value) | -2.764 | -2.598 | -2.612 | -2.625 | -2.727 | -2.664 | -2.676 | -2.607 | -2.710 | -2.619 |
| % Error | 4.336 | 1.941 | 0.337 | 0.755 | 2.172 | 1.098 | 0.215 | 0.372 | 3.119 | 1.451 |

### Table 16: Journal of Earth System Science.

|   | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|------|------|------|------|------|------|------|------|------|------|------|
| No. of papers | 59   | 66   | 88   | 106  | 121  | 140  | 127  | 143  | 135  | 131  | 235  |
| Total citation (TC) | 996  | 1108 | 1204 | 1473 | 1503 | 1163 | 1026 | 799  | 649  | 322  | 266  |
| H-core citation (HC) | 324  | 289  | 361  | 441  | 361  | 225  | 256  | 169  | 144  | 49   | 25   |
| Net excess citation (EC) | 672  | 819  | 843  | 1032 | 1142 | 938  | 770  | 630  | 505  | 273  | 241  |
| $\epsilon$ | 0.821 | 0.860 | 0.837 | 0.837 | 0.872 | 0.898 | 0.866 | 0.888 | 0.882 | 0.921 | 0.952 |
| $\theta$ | 0.694 | 0.594 | 0.654 | 0.654 | 0.562 | 0.490 | 0.577 | 0.518 | 0.534 | 0.424 | 0.322 |
| $d\epsilon$ | 0.038 | -0.023 | 0.000 | 0.035 | 0.026 | -0.032 | 0.022 | -0.006 | 0.039 | 0.031 |
| $d\theta$ | -0.100 | 0.060 | -0.001 | -0.091 | -0.072 | 0.087 | -0.059 | 0.016 | -0.110 | -0.102 |
| CSF = $d\theta/d\epsilon$ (Observed Value) | -2.616 | -2.626 | -2.608 | -2.640 | -2.745 | -2.733 | -2.709 | -2.743 | -2.854 | -3.269 |
| CSF = $-R^3/(h*e^2)$ (Expected Value) | -2.649 | -2.608 | -2.609 | -2.685 | -2.819 | -2.668 | -2.758 | -2.728 | -3.024 | -3.600 |
| % Error | 1.230 | 0.668 | 0.005 | 1.701 | 2.616 | 2.473 | 1.781 | 0.525 | 5.619 | 9.200 |

### Table 17: Journal of Medical Physics.

|   | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|------|------|------|------|------|------|------|------|------|------|------|
| No. of papers | 40   | 38   | 35   | 37   | 35   | 41   | 40   | 44   | 45   | 40   | 40   |
| Total citation (TC) | 418  | 624  | 292  | 301  | 279  | 270  | 174  | 161  | 161  | 48   | 10   |
| H-core citation (HC) | 121  | 100  | 100  | 64   | 81   | 100  | 49   | 49   | 36   | 16   | 1    |
| Net excess citation (EC) | 297  | 524  | 192  | 237  | 198  | 170  | 125  | 112  | 125  | 32   | 9    |
| $\epsilon$ | 0.843 | 0.916 | 0.811 | 0.887 | 0.842 | 0.793 | 0.848 | 0.834 | 0.881 | 0.816 | 0.949 |
| $\theta$ | 0.638 | 0.437 | 0.722 | 0.520 | 0.640 | 0.767 | 0.626 | 0.661 | 0.537 | 0.707 | 0.333 |
| $d\epsilon$ | 0.073 | -0.105 | 0.076 | -0.045 | -0.049 | 0.054 | -0.014 | 0.047 | -0.065 | 0.132 |
| $d\theta$ | -0.201 | 0.285 | -0.202 | 0.120 | 0.127 | -0.141 | 0.035 | -0.125 | 0.170 | -0.374 |
| CSF = $d\theta/d\epsilon$ (Observed Value) | -2.743 | -2.700 | -2.642 | -2.670 | -2.603 | -2.604 | -2.613 | -2.651 | -2.637 | -2.828 |
| CSF = $-R^3/(h*e^2)$ (Expected Value) | -2.975 | -2.599 | -2.754 | -2.615 | -2.610 | -2.623 | -2.606 | -2.724 | -2.598 | -3.514 |
| % Error | 7.806 | 3.898 | 4.062 | 2.109 | 0.263 | 0.712 | 0.299 | 2.688 | 1.499 | 19.525 |
Table 18: Journal of Scientific and Industrial Research.

| Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|------|------|------|------|------|------|------|------|------|------|------|
| No. of papers | 114  | 103  | 106  | 76   | 81   | 101  | 94   | 76   | 14   | 36   | 10   |
| Total citation (TC) | 2002 | 1447 | 857  | 492  | 496  | 607  | 287  | 207  | 52   | 62   | 19   |
| H-core citation (HC) | 484  | 324  | 225  | 144  | 100  | 121  | 49   | 49   | 25   | 16   | 4    |
| Net excess citation (EC) | 1518 | 1123 | 632  | 348  | 396  | 486  | 238  | 158  | 27   | 46   | 15   |
| $\varepsilon = \sqrt{EC/TC}$ (FET) | 0.871 | 0.881 | 0.859 | 0.841 | 0.894 | 0.895 | 0.911 | 0.874 | 0.721 | 0.861 | 0.889 |
| $\theta = \sqrt{HC/EC}$ (FHE) | 0.565 | 0.537 | 0.597 | 0.643 | 0.503 | 0.499 | 0.454 | 0.557 | 0.962 | 0.590 | 0.516 |
| $d\varepsilon$ | 0.010 | -0.022 | -0.018 | 0.053 | 0.001 | 0.016 | -0.037 | -0.153 | 0.141 | 0.027 |
| $d\theta$ | -0.028 | 0.060 | 0.047 | -0.141 | -0.004 | -0.045 | 0.103 | 0.405 | -0.372 | -0.073 |
| CSF = $d\theta/d\varepsilon$ (Observed Value) | -2.702 | -2.681 | -2.628 | -2.681 | -2.793 | -2.854 | -2.789 | -2.648 | -2.646 | -2.701 |
| CSF = $-R^3/(h*e^2)$ (Expected Value) | -2.723 | -2.646 | -2.613 | -2.790 | -2.797 | -2.918 | -2.693 | -2.778 | -2.653 | -2.761 |
| % Error | 0.780 | 1.305 | 0.567 | 3.899 | 0.142 | 2.202 | 3.584 | 4.668 | 0.277 | 2.169 |

Table 19: Journal of Vibrational Engineering and Technologies.

| Year | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|------|------|------|------|------|------|
| No. of papers | 18   | 57   | 60   | 60   | 49   | 91   |
| Total citation (TC) | 50   | 241  | 136  | 101  | 90   | 122  |
| H-core citation (HC) | 25   | 64   | 25   | 25   | 25   | 25   |
| Net excess citation (EC) | 25   | 177  | 111  | 76   | 65   | 97   |
| $\varepsilon = \sqrt{EC/TC}$ (FET) | 0.707 | 0.857 | 0.903 | 0.867 | 0.850 | 0.892 |
| $\theta = \sqrt{HC/EC}$ (FHE) | 1.000 | 0.601 | 0.475 | 0.574 | 0.620 | 0.508 |
| $d\varepsilon$ | 0.150 | 0.046 | -0.036 | -0.018 | 0.042 |
| $d\theta$ | -0.399 | -0.127 | 0.099 | 0.047 | -0.113 |
| CSF = $d\theta/d\varepsilon$ (Observed Value) | -2.660 | -2.730 | -2.751 | -2.647 | -2.689 |
| CSF = $-R^3/(h*e^2)$ (Expected Value) | -2.642 | -2.858 | -2.671 | -2.627 | -2.778 |
| % Error | 0.670 | 4.481 | 2.992 | 0.763 | 3.218 |

Table 20: Pramana - Journal of Physics.

| Year | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|------|------|------|------|------|------|------|------|------|------|------|
| No. of papers | 178  | 222  | 188  | 234  | 234  | 217  | 213  | 191  | 237  | 184  | 170  | 201  |
| Total citation (TC) | 1260 | 1268 | 1093 | 1161 | 1205 | 582  | 748  | 899  | 818  | 628  | 591  |
| H-core citation (HC) | 289  | 289  | 289  | 289  | 289  | 324  | 324  | 324  | 324  | 324  | 324  |
| Net excess citation (EC) | 971  | 979  | 804  | 837  | 881  | 81   | 144  | 144  | 169  | 121  | 121  |
| $\varepsilon = \sqrt{EC/TC}$ (FET) | 0.878 | 0.879 | 0.858 | 0.894 | 0.855 | 0.928 | 0.899 | 0.916 | 0.891 | 0.899 | 0.892 |
| $\theta = \sqrt{HC/EC}$ (FHE) | 0.546 | 0.543 | 0.600 | 0.622 | 0.606 | 0.402 | 0.488 | 0.437 | 0.510 | 0.489 | 0.507 |
| $d\varepsilon$ | 0.001 | -0.021 | -0.009 | 0.006 | 0.073 | -0.029 | 0.018 | -0.026 | 0.008 | -0.007 |
| $d\theta$ | -0.002 | 0.056 | 0.023 | -0.016 | -0.204 | 0.086 | -0.052 | 0.074 | -0.022 | 0.019 |
| CSF = $d\theta/d\varepsilon$ (Observed Value) | -2.711 | -2.675 | -2.634 | -2.632 | -2.809 | -2.951 | -2.893 | -2.864 | -2.797 | -2.800 |
| CSF = $-R^3/(h*e^2)$ (Expected Value) | -2.713 | -2.644 | -2.626 | -2.638 | -3.114 | -2.823 | -2.975 | -2.773 | -2.822 | -2.779 |
| % Error | 0.065 | 1.185 | 0.327 | 0.235 | 9.797 | 4.555 | 2.746 | 3.280 | 0.893 | 0.751 |
### Table 21: Proceedings of the Indian National Science Academy.

| Year | No. of papers | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|---------------|------|------|------|------|------|------|------|------|------|------|------|
|      |               |      |      |      |      |      |      |      |      |      |      |      |
|      | Total citation (TC) |      |      |      |      |      |      |      |      |      |      |      |
|      | H-core citation (HC) |      |      |      |      |      |      |      |      |      |      |      |
|      | Net excess citation (EC) |      |      |      |      |      |      |      |      |      |      |      |
|      | ϵ=Sqrt(EC/TC) (FET) |      |      |      |      |      |      |      |      |      |      |      |
|      | θ=Sqrt(HC/EC) (FHE) |      |      |      |      |      |      |      |      |      |      |      |
|      | % Error |      |      |      |      |      |      |      |      |      |      |      |

### Table 22: Proceedings of the National Academy of Sciences India Section A - Physical Sciences.

| Year | No. of papers | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|------|---------------|------|------|------|------|------|------|------|------|------|------|------|
|      |               |      |      |      |      |      |      |      |      |      |      |      |
|      | Total citation (TC) |      |      |      |      |      |      |      |      |      |      |      |
|      | H-core citation (HC) |      |      |      |      |      |      |      |      |      |      |      |
|      | Net excess citation (EC) |      |      |      |      |      |      |      |      |      |      |      |
|      | ϵ=Sqrt(EC/TC) (FET) |      |      |      |      |      |      |      |      |      |      |      |
|      | θ=Sqrt(HC/EC) (FHE) |      |      |      |      |      |      |      |      |      |      |      |
|      | % Error |      |      |      |      |      |      |      |      |      |      |      |

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Das and Dutta: Measuring citation diffusion by Citation Swing Factor