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2014 IEEE International Conference on  
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9 - 12 December 2014, Malaysia

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## Do We Miscount Patent Citations? An Empirical Study on the Impact of Overlooking the Citations to a Patent's Pre-grant Publication

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- Patents, like academic papers, are often evaluated by its citation counts
- Similarly, the more a patent is cited, the patent is considered as
  - Having better quality
  - More valuable
  - More important
  - Producing more impact/influence

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(12) **United States Patent**  
**Jang et al.**

(10) **Patent No.:** **US 7,782,101 B2**  
(45) **Date of Patent:** **Aug. 24, 2010**

(54) **INJECTION-LOCKED FREQUENCY DIVIDER**

(75) Inventors: **Sheng-Lyang Jang**, Taipei (TW);  
**Cheng-Chen Liu**, Taipei (TW)

(73) Assignee: **National Taiwan University of Science and Technology**, Taipei (TW)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 152 days.

(21) Appl. No.: **12/164,117**

(22) Filed: **Jun. 30, 2008**

(65) **Prior Publication Data**

US 2009/0251177 A1 Oct. 8, 2009

(30)

Apr. 3, 2009

(51) Int. C.

H03B

(52) U.S. C.

(58) Field

327/118

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2007/0257735 A1 11/2007 Chan et al.  
2008/0278250 A1 \* 11/2008 Hung et al. .... 331/117 R  
2009/0189704 A1 \* 7/2009 Li ..... 331/117 R

## FOREIGN PATENT DOCUMENTS

JP	55096737	7/1980
TW	I283966	7/2007

## OTHER PUBLICATIONS

Author: Sheng-Lyang Jang, and Chien-Feng Lee Title: A Wide Locking Range LC-Tank Injection-Locked Frequency Divider Date: Aug. 2007 Publisher: IEEE Volume: IEEE Microwave and Wireless Components Letters, vol. 17, No. 8.\*

Author: Sheng-Lyang Jang, Chien-Feng Lee, and Wei-Hsung Yeh Title: A Divide-by-3 Injection Locked Frequency Divider With Single-Ended Input Date: Feb. 2008 Publisher: IEEE Volume: IEEE Microwave and Wireless Components Letters, vol. 18, No. 2.\*

Author: Sheng-Lyang Jang, and Shao-Hwa Lee Title: A Wide Band Injection Locked Frequency Divider With Variable Inductor Load Date: Jun. 2007 Publisher: IEEE Volume: IEEE Microwave and Wireless Components Letters, vol. 17, No. 6.\*

\* cited by examiner

Primary Examiner—Arnold Kinkead

Chyun IP Office

Full-text image for US Patent  
No. 7,782,101

er for dividing a fre-  
obtaining a frequency  
tion-locked frequency  
and an oscillator. The  
input terminal and a  
the injection signal. The

received injection signal exhibits a phase difference of 180° between the first input terminal and the second input terminal. The oscillator includes an inductor unit and a variable capacitance unit. The injection-locked frequency divider is featured with a wide injection locking range, and can be realized with a low operation voltage, and therefore can be conveniently used in different kinds of hybrid ICs.

**25 Claims, 6 Drawing Sheets**

## USPTO PATENT FULL-TEXT AND IMAGE DATABASE

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*Searching US Patent Collection...*

**Results of Search in US Patent Collection db for:**

**REF/5376580:** 240 patents.

*Hits 1 through 50 out of 240*

[Next 50 Hits](#)[Jump To](#)[Refine Search](#)

**PAT.  
NO.**

**Title**

1 [8.778.783](#) [Methods for improved growth of group III nitride buffer layers](#)

Screen capture of USPTO  
advanced search interface  
showing 240 patents citing US  
Patent No. 5,376,580

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However, most analyses involving patent citations use ONLY issued patent

But, other than the issued patent, a utility patent application also has a pre-grant publication (PGPub)

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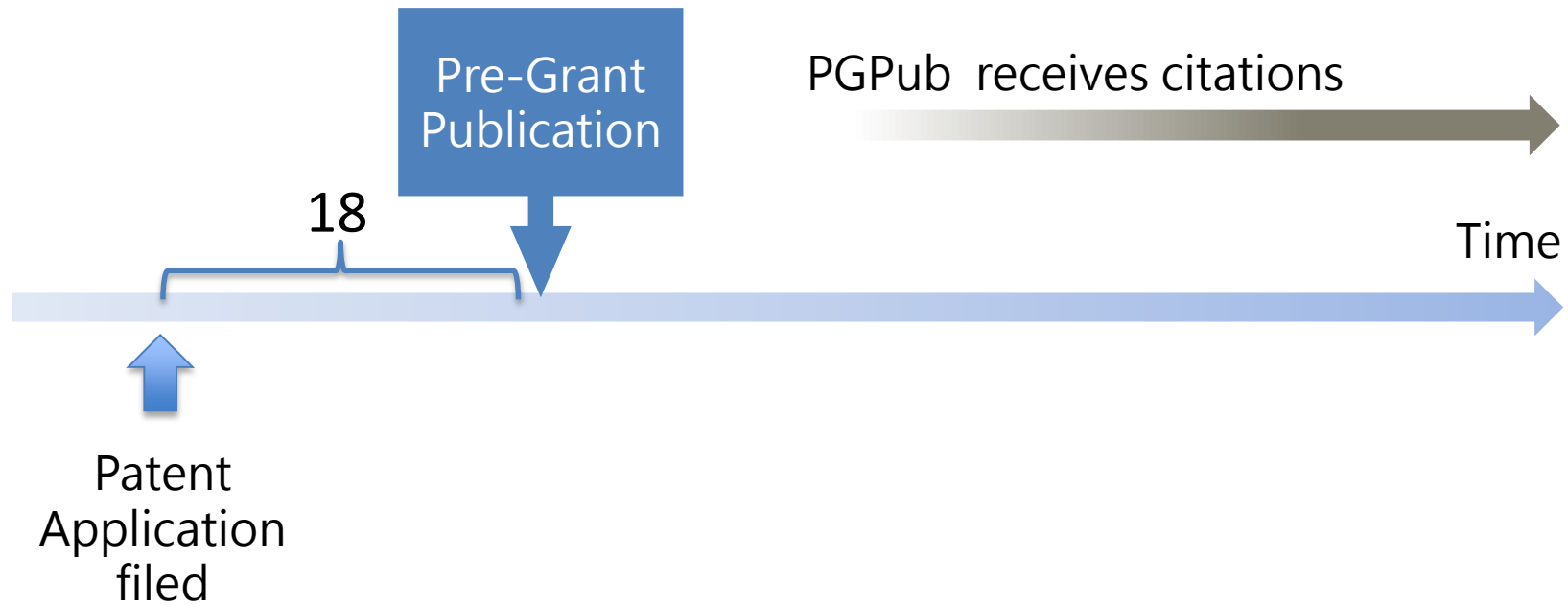
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A pre-grant publication (PGPub) is a public document of an utility patent application published 18 months after filing



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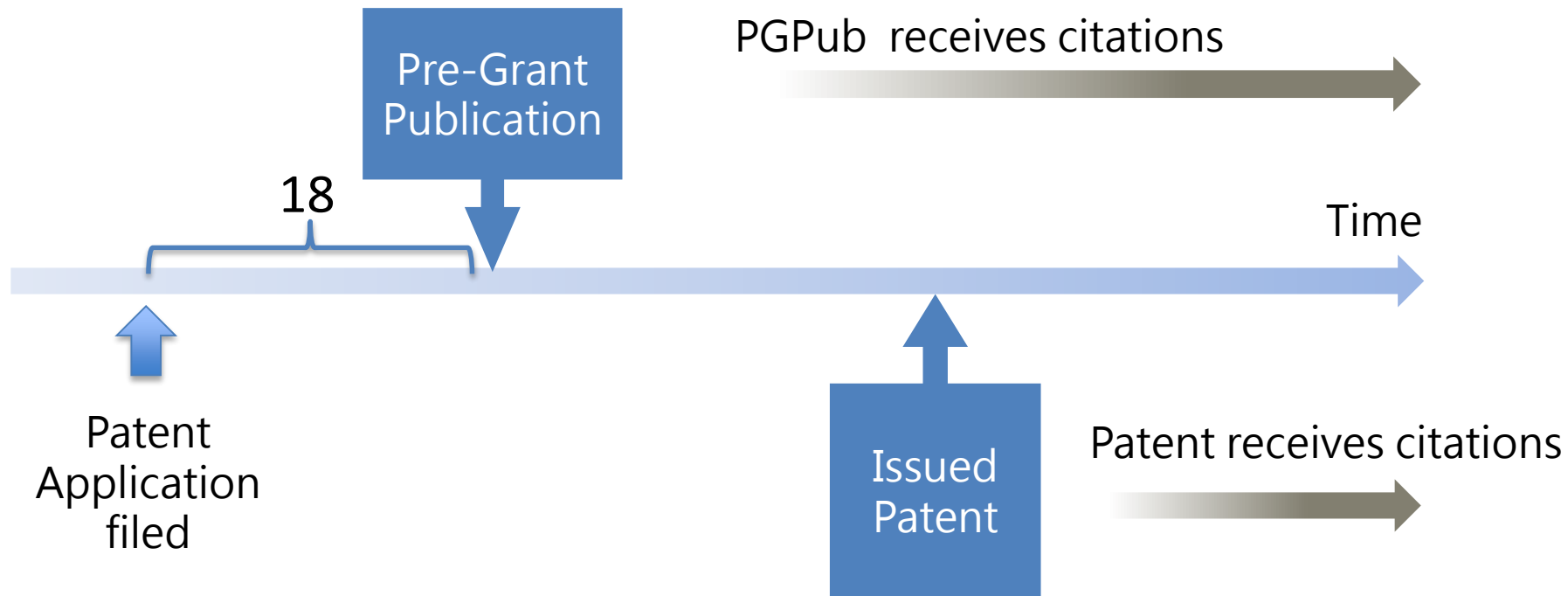
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The PGPub and the subsequently issued patent are independently and individually cited.



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## Results of Search in US Patent Collection db for:

REF/7657849: 99 patents.

Hits 1 through 50 out of 99

Final 49 Hits

Citations to patent US7,657,849

Jump To

Refine Search

REF/7657849

### PAT. NO.

- 1 [8.893.033](#) [Application notifications](#)
- 2 [8.892.170](#) [Unlock screen](#)
- 3 [8.881.269](#) [Device, method, and graphical user interface](#)
- 4 [8.881.025](#) [Systems, apparatus, methods and computer programs](#)
- 5 [8.875.059](#) [Control of a device using gestures](#)
- 6 [8.872.730](#) [Portable device and method for control](#)

## Results of Search in US Patent Collection db for:

REF/2007/0150842: 119 patents.

Hits 1 through 50 out of 119

Next 50 Hits

Citations to the corresponding  
PGPub 2007/0150842

Jump To

Refine Search

ref/2007/0150842

### PAT. NO.

- 1 [8.893.055](#) [Mobile terminal and operating method](#)
- 2 [8.893.053](#) [Method and apparatus for altering mo](#)
- 3 [8.892.170](#) [Unlock screen](#)
- 4 [8.884.926](#) [Light-based finger gesture user interf](#)
- 5 [8.881.025](#) [Systems, apparatus, methods and com](#)
- 6 [8.874.162](#) [Mobile device safe driving](#)
- 7 [8.872.796](#) [Mobile terminal and operation contro](#)

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Results of Search in US Patent Collection db for:  
(REF/7657849 AND REF/2007/0150842): 30 patents.  
*Hits 1 through 30 out of 30*











30 subsequent patents citing  
both US 7,657,849  
and its PGPub

Jump To

Refine Search

ref/7657849 AND REF/2007/0150842

## PAT. NO.

- 1 [8.892.170](#)  [Unlock screen](#)
- 2 [8.881.025](#)  [Systems, apparatus, methods and compu](#)
- 3 [8.825.699](#)  [Contextual search by a mobile communi](#)
- 4 [8.811.948](#)  [Above-lock camera access](#)
- 5 [8.797.286](#)  [User interface and method for managing](#)
- 6 [8.781.533](#)  [Alternative inputs of a mobile communic](#)
- 7 [8.756.534](#)  [Methods and graphical user interfaces fo](#)
- 8 [8.719.695](#)  [Devices, methods, and graphical user int](#)
- 9 [8.677.232](#)  [Devices, methods, and graphical user int](#)
- 10 [8.661.362](#)  [Methods and graphical user interfaces fo](#)

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## The Question: what is the impact of ignoring the citations to PGPubs?

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- Empirical Data

- Collect 137,964 utility patents issued in year 2007 from USPTO
  - Why 2007? We'd like to give the issued patents enough time to accumulate their citations
- Count the citations to the 137,964 patents and their corresponding PGPubs
- Calculate their *PGPub Citation Shares*:

$$PGPub\ Citation\ Share = \frac{|PGPub\ Citations|}{|PGPub\ Citations \cup Patent\ Citation|}$$



- *PGPub Citation Share* reflects the degree of impact when citations to PGPub are ignored
  - PGPub Citation Share=**0%**
    - **No impact at all**
    - Special case: citation counts of PGPub and Patent are both 0, the PGPub Citation Share is considered as **0%**
  - PGPub Citation Share=**100%**
    - The patent is **completely underestimated**.
  - PGPub Citation Share > **50%**
    - More citation to the PGPub to the issued patent

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- Overall statistics

	PGPubs	Patents
Total citation count	705,714	696,405
Avg. citation count*	5.12	5.05
Max. citation count**	405	392
Max. difference	360	363

\*The standard deviations are 11.92 and 10.72, respectively.

\*\*Their corresponding patent and PGPub receive 45 and 29 citations only.

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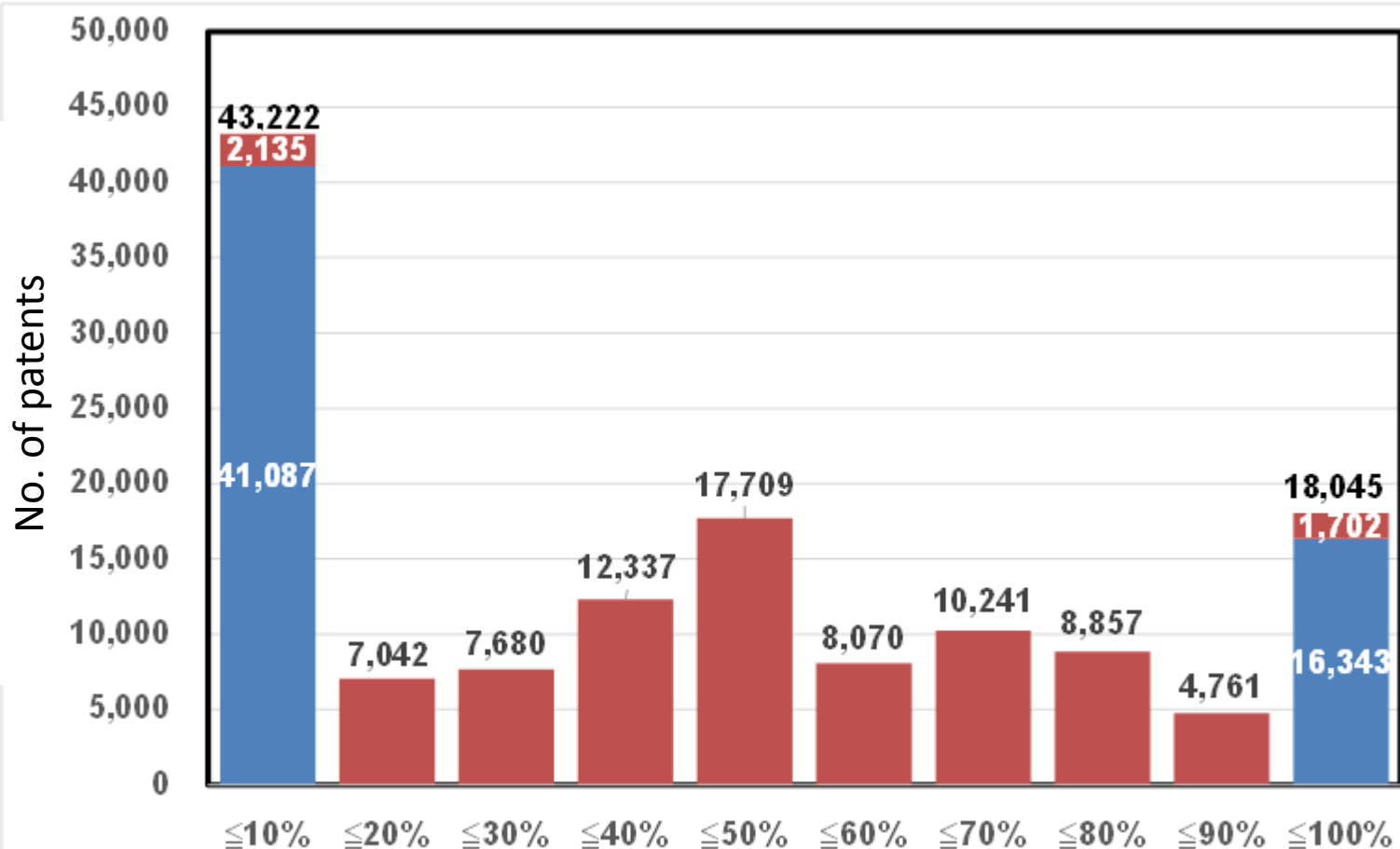




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Distribution of PGPub Citation shares of all 137,964 patents

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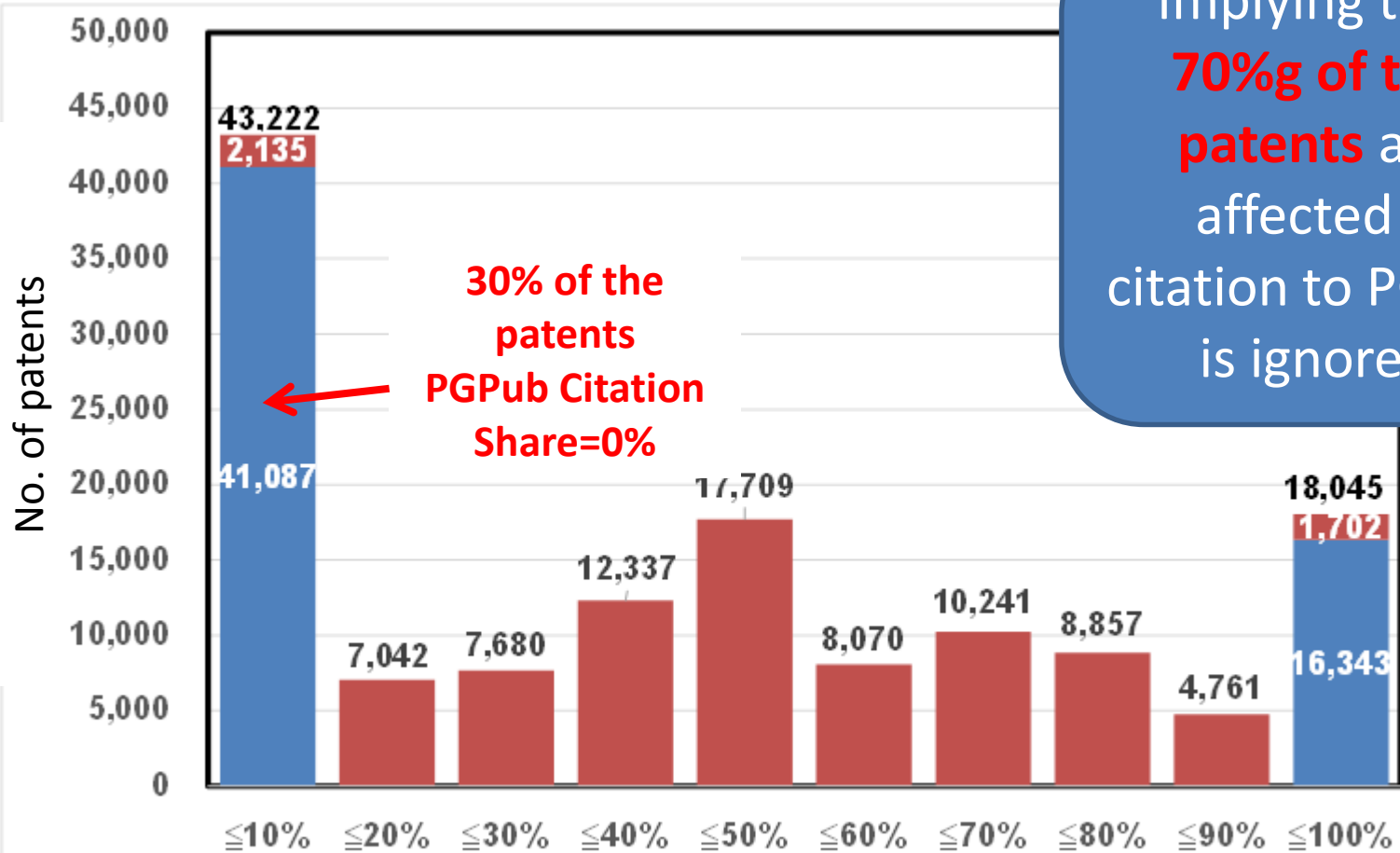
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Implying that  
**70%g of the  
patents** are  
affected if  
citation to PGPub  
is ignored

Distribution of PGPub Citation shares of all 137,964 patents

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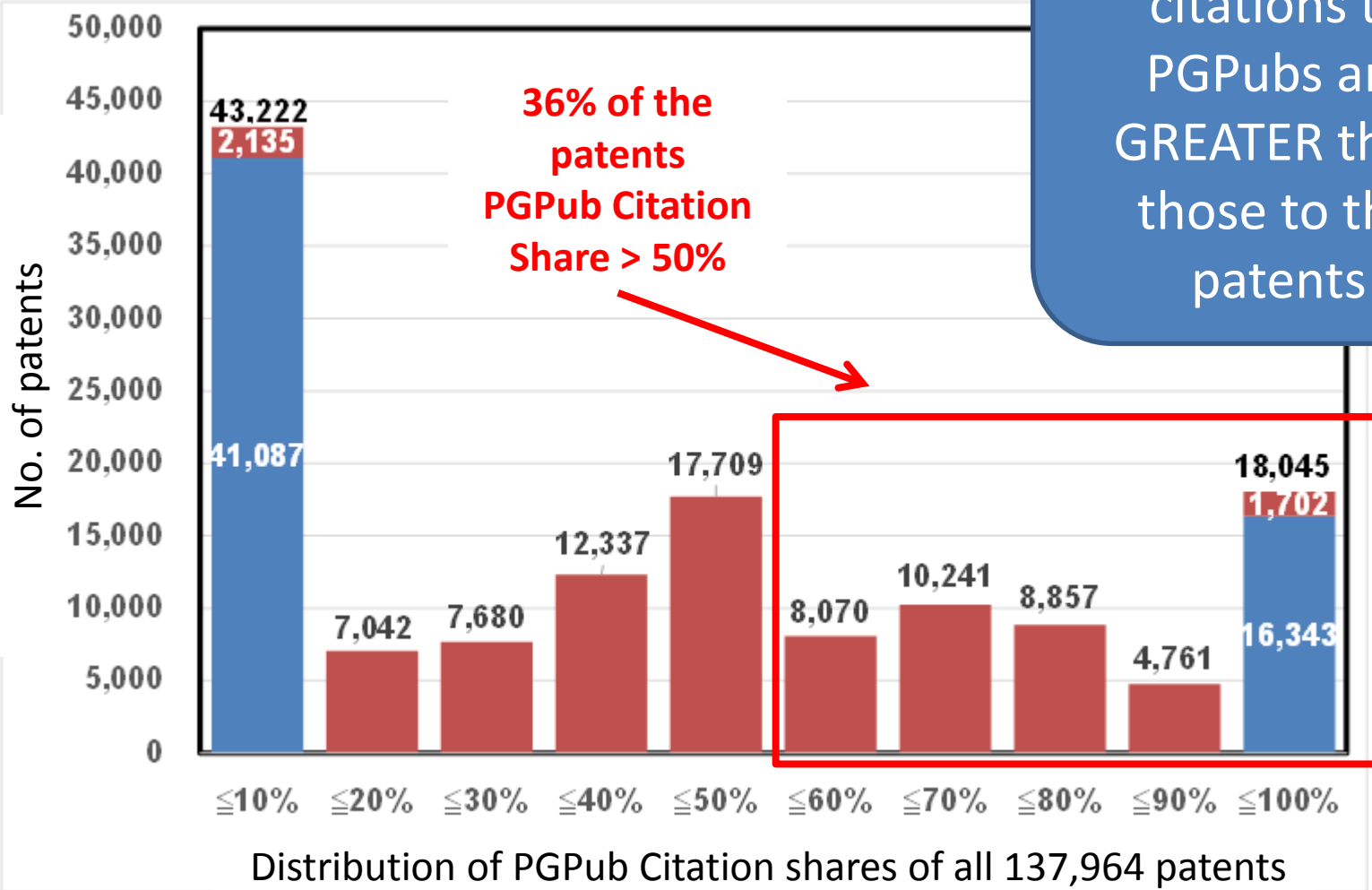


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These patents' citations to PGPub are GREATER than those to the patents



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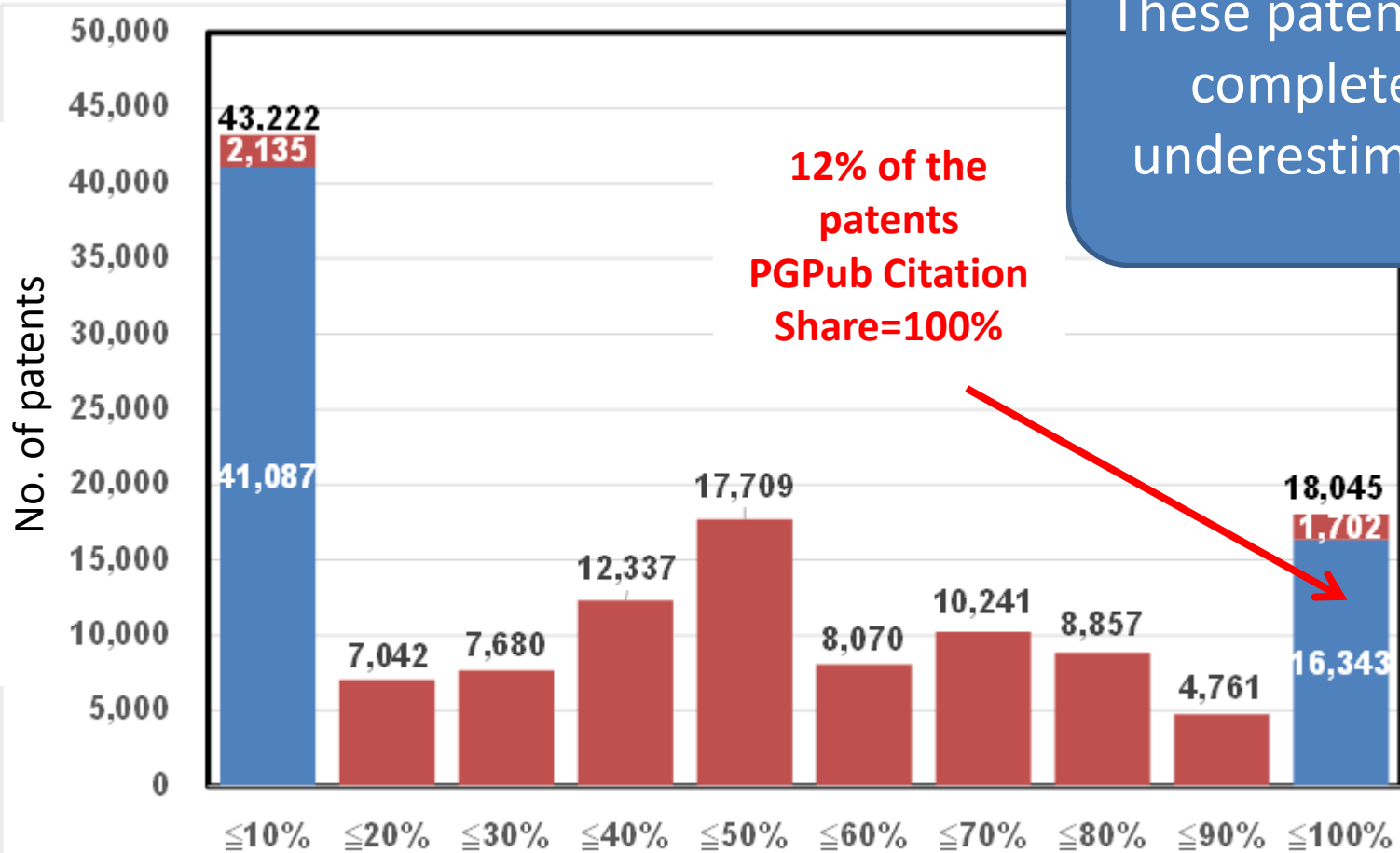




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These patents are  
completely  
underestimated

12% of the  
patents  
PGPub Citation  
Share=100%

Distribution of PGPub Citation shares of all 137,964 patents

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- Conclusion
  - **An analyst should not ignore citations to the PGPubs easily** without evaluating the impact first
    - About 70% of the patents are underestimated to various degrees
    - 36% of the patents are significantly underestimated
    - 12% of the patents are completely underestimated

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- One may argue...
  - The content of a PGPub may be different from that of its corresponding patent, thereby justifying their citations are not counted together.
  - U.S. Patent Act (35 U.S.C.S. § 132(a)) specifies that “No amendment shall introduce new matter into the disclosure of the invention.”
  - The contents of the PGPub and the patent should both be bounded by what is disclosed at the time of filing.

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- Extension of the Study
  - We speculate that citations to PGPubs should be even more significant for younger patents.
  - We have finished collecting utility patents issued in 2009 and 2011
    - Analytical result to be reported in the future.

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