



# revista facultad de ingeniería

Universidad de Antioquia

---

September, 2017

No.  
**84**

ISSN 0120-6230

e-ISSN 2422-2844



**No. 84**

September, 2017  
ISSN 0120-6230  
e-ISSN 2422-2844

**Rector**

Mauricio Alviar Ramírez

**Dean**

Jesús Francisco Vargas Bonilla

**Editor-in-Chief**

Maryory Astrid Gómez Botero

**Editorial Board**

Luis Ribeiro  
Geosistemas  
Instituto Superior Técnico  
Lisboa, Portugal

Eduardo Miró  
Instituto de Investigaciones en Catálisis y Petroquímica (INCAPE, CONICET)  
Santa Fe, Argentina

Eduardo Miró  
Instituto de Investigaciones en Catálisis y Petroquímica (INCAPE, CONICET)  
Santa Fe, Argentina

Octavio Armas Vergel  
ETS Ingenieros Industriales Ciudad Real, Universidad de Castilla-La Mancha, España

Jean Denis Taupin  
HydroSciences, Institute de recherche pour le développement  
Montpellier, Francia

Román Hermida  
Facultad de Informática  
Universidad Complutense de Madrid,  
España

Oscar Rosa Mattos  
Departamento Engenharia Metalúrgica e de Materiais  
Universidade Federal do Rio de Janeiro  
Brasil

Eduardo Sánchez  
École Polytechnique Fédérale de Lausanne,  
Switzerland

Carles Corbella Roca  
Faculty of Physics and Astronomy  
Ruhr-University Bochum, Germany  
Ángel Pérez del Pino  
Instituto de Ciencia de Materiales de Barcelona  
Consejo Superior de Investigaciones Científicas CSIC, España

Claudio Avignone Rossa  
Faculty of Health and Medical Sciences  
University of Surrey, United Kingdom

Dr. Jordi Morató Farreras  
Coordinador Cátedra UNESCO de Sostenibilitat  
Universitat Politècnica de Catalunya, España

Julián Andrés Rengifo Herrera  
Centro de Investigación y Desarrollo en  
Ciencias Aplicadas, Argentina

Dr. Luis Armando Díaz Torres  
Grupo de Espectroscopia de Materiales Avanzados y  
Nanoestructurados (GEMANA) Centro de Investigaciones en  
Óptica, México

Lin, Hua-Tay  
School of Electromechanical Engineering, Guangdong  
University of Technology, China

Kamal H. Khayat  
Center for Infrastructure Engineering Studies, Missouri University  
of Science & Technology, United States

Waltraud M. Kriven  
Department of Mechanical Science and Engineering  
University of Illinois at Urbana-Champaign, United States

Juan Claudio Nino  
Department of Materials Science and Engineering  
University of Florida  
United States

Watson Vargas Escobar  
Dpto. de Ingeniería Química  
Universidad de los Andes, Colombia

Jorge Andrés Calderón Gutiérrez  
Dpto. de Ingeniería de Materiales  
Universidad de Antioquia, Colombia

Sebastián Isaza Ramírez  
Dpto. Ingeniería Electrónica  
Universidad de Antioquia, Colombia

Julián David Arias Londoño  
Dpto. Ingeniería de Sistemas  
Universidad de Antioquia, Colombia

Elena Valentina Gutiérrez Gutiérrez  
Dpto. Ingeniería Industrial  
Universidad de Antioquia, Colombia

Fernando León Guzmán Duque  
Dpto. Ingeniería Química  
Universidad de Antioquia, Colombia

Julio César Saldarriaga Molina  
Escuela Ambiental  
Universidad de Antioquia, Colombia

**Scientific Board**

Jesús Casanova Kindelan  
Ingeniería Energética y  
Fluidomecánica, Universidad Politécnica de Madrid, España

Esteban Abad Holgado  
Investigaciones Químicas y Ambientales, Consejo Superior de  
Investigaciones Científicas  
Barcelona, España

Georgina Fernández Villagómez  
Ingeniería Química  
Universidad Nacional Autónoma de México

Jiahua Jack Zhu  
Department of Chemical and Biomolecular Engineering  
University of Akron  
United States



Vijay Gupta  
Mechanical and Aerospace Engineering  
Biomedical Engineering  
Materials Science and Engineering  
University of California, Los Angeles  
United States

Jean Paul Allain  
Radiation Surface Science and Engineering Lab (RSEEL)  
Department of Nuclear, Plasma, and Radiological Engineering  
University of Illinois  
At Urbana-Champaign, United States

Dileep Singh  
Argonne National Laboratory  
Argonne, Illinois, United States

Hernán E.M Carvajal  
Programa de Posgraduación en Geotecnia, Universidad de Brasilia  
Facultad de Minas,  
Universidad Nacional de Colombia

Néstor Jaime Aguirre Ramírez  
Escuela Ambiental  
Universidad de Antioquia, Colombia

Henry A. Colorado  
Sociedad Colombiana de Materiales y Minerales  
Ingeniería Mecánica  
Universidad de Antioquia, Colombia

**Administrative Assistant**  
Sandra Hernández Barrientos

**Proofreading**  
Alison Ríos Barrera  
Leidy Johana Hernández Zuluaga  
Juan Diego A. Prada Ramírez

English Proofreading  
Claudia E. Urrego Zapata

**Book Cover**  
Image "Schematic diagram of the experimental set-up" by  
Velmurugan Kolanjiappan

**Layout and printing**  
L. Vieco S.A.S.  
comercial@lvieco.com

**Post**  
Reduced postal fare N° 842

**E-mail**  
revistaingenieria@udea.edu.co

**Web site**  
redin.udea.edu.co

The contents or any other legal restriction related to the articles is responsibility of the authors.

This issue was supported by Indexed Journals Fund of the Vice-President for Research, University of Antioquia Press

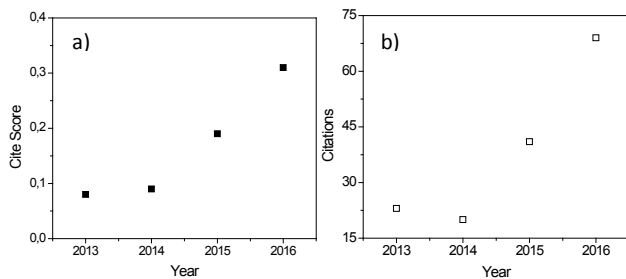
**Objective of Revista Facultad de Ingeniería**  
"The principal objective of the Revista Facultad de Ingeniería is to promote the publication of original and unpublished articles derived from experimental research, engineering simulations or review papers, developed by researchers and experts from national or international, public or private institutions."

# Table of contents

Editorial.....	7
Supply chain design using a modified IWD algorithm Luis Antonio Moncayo-Martínez.....	9
Accelerating the computation of the volume of tissue activated during deep brain stimulation using Gaussian processes Iván De La Pava Panche, Viviana Gómez-Orozco, Mauricio Alexander Álvarez-López, Óscar Alberto Henao-Gallo, Genaro Daza-Santacoloma, Álvaro Ángel Orozco-Gutiérrez.....	17
Biocompatibility of bismuth silicate coatings deposited on 316L stainless steel by sol-gel process Jorge Hernando Bautista-Ruiz, Jhon Jairo Olaya-Flórez, Willian Arnulfo Aperador-Chaparro.....	27
Influence of the molecular weight of polymer, solvents and operational condition in the electrospinning of polycaprolactone Gabriel Jaime Colmenares-Roldán, Yeixon Quintero-Martínez, Liliana María Agudelo-Gómez, Luis Fernando Rodríguez-Vinasco, Lina Marcela Hoyos-Palacio.....	35
Reduction of amine and biological antioxidants on NOx emissions powered by mango seed biodiesel Velmurugan Kolanjiappan.....	46
Effect of surface hardness and roughness produced by turning on the torsion mechanical properties of annealed AISI 1020 steel Omar José Zurita-Hurtado, Verónica Carmen Di Graci-Tiralongo, María Cristina Capace-Aguirre.....	55
Identification of the characteristics incident to the detection of non-technical losses for two Colombian energy companies Carmen Cecilia Sánchez-Zuleta, Juan Pablo Fernández-Gutiérrez, Carlos César Piedrahita-Escobar.....	60
Information quality and quantity-based model to represent the appropriateness of software requirements elicitation techniques Luis Aguirre-Arredondo, Dante Carrizo-Moreno.....	72
Approaching the concepts of ecosystems resilience and stability through spatiotemporal system dynamics and agent-based modelling Sebastián Peña-Alzate, Julio Eduardo Cañón Barriña.....	84
Oxidative dehydrogenation of propane with cobalt, tungsten and molybdenum based materials Maurin Salamanca-Guzmán, Yordy Enrique Licea-Fonseca, Adriana Echavarría-Isaza, Arnaldo Faro, Luz Amparo Palacio-Santos.....	97

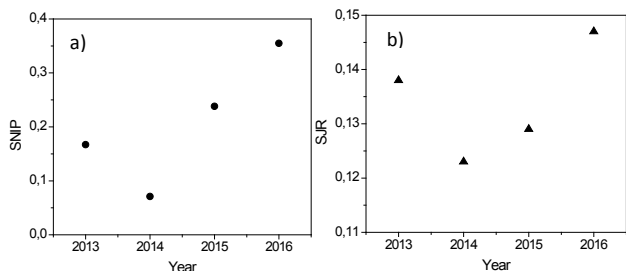
# EDITORIAL

In the present editorial, the analysis of the behavior of some bibliometric indicators of the Revista Facultad de Ingeniería Journal in the last years will be carried out. Adopting SCOPUS as a source, the Cite Score has been increasing from 0.08 to 0.31 (Figure 1 (a)), exhibiting a significant increase in the relation between the citations of the documents published in each of the related years and the number of documents published in the immediately preceding 3 years. The number of citations the journal has had over the last four years exhibits a parallel behavior (Figure 1 (b)) [1].



**Figure 1 Behavior of a) Cite Score and b) citations for the Revista Facultad de Ingeniería in recent years**

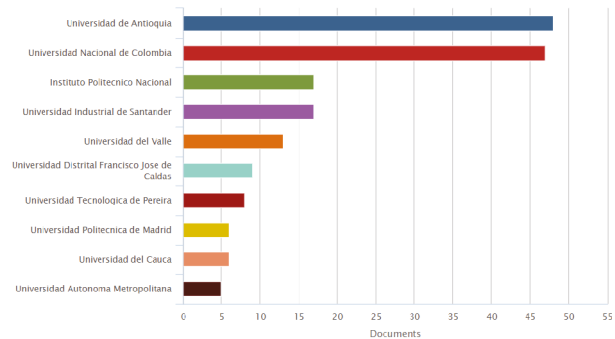
The SNIP (Source Normalized Impact per Paper) calculated for the Revista Facultad de Ingeniería shows an increase from 0.071 in 2014 to 0.355 in 2016 (Figure 2 (a)). This indicator lists the actual citations received with the citations expected within the thematic field [1]. The SJR (SCImago Journal Rank) takes the SCOPUS data and weighs the citations that each journal receives according to the SJR of the cited journal. The citations received from the journals with the highest SJR index are worth more than those received by those with the lowest SJR index [1,2]. Figure 2 (b) shows the JRS behavior for the journal in the last four years.



**Figure 2 Behavior of bibliometric indicators for the Revista Facultad de Ingeniería a) SNIP and b) SJR**

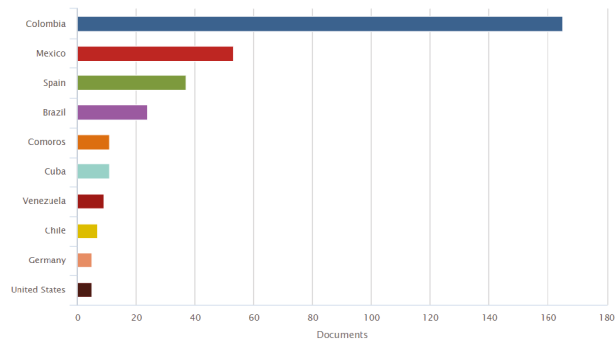
In the same period from 2013 -2016, the authors of the articles published in the Revista Facultad de Ingeniería Journal have institutional affiliation predominantly to Universidad de Antioquia and Universidad Nacional de

Colombia, followed by the Politécnico Nacional de México and other national universities (Figure 3). From the first 10 institutions registered by SCOPUS, three are international institutions including the Universidad Politécnica de Madrid and the Universidad Autónoma Metropolitana de México [1]. However, these data should be carefully observed, according to Figure 3, it seems that authors of the Universidad de Antioquia published a high percentage of the articles of the journal, but this indicator also includes the editorials and letters to the editor. The journal in its editorial policies ensures that each published issue does not exceed 30% of authors of the same institution.



**Figure 3 Distribution of the affiliated institutions of the authors publishing in the Revista Facultad de Ingeniería Journal.**

In the same period of 2013-2016, Figure 4 shows the distribution of the first ten countries of origin of the authors who publish in our journal. Colombia is the first country, followed by Mexico, Spain, Brazil, Comoros, Cuba, Venezuela, Chile, Germany and the United States.



**Figure 4 Affiliation countries of authors publishing in the Revista Facultad de Ingeniería Journal.**

Figure 5 shows the behavior of the international collaboration that is perceived in the articles published in the journal since 2009, taken from Scimago [3]. This decrease in international

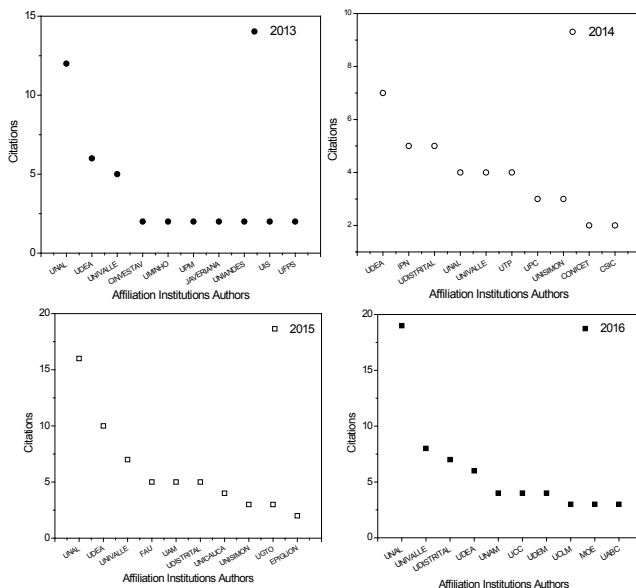
collaboration in recent years is interpreted as a consequence of the crisis occurring in the country with the noticeable and progressive cut of the budget for Science, Technology and Innovation. Lack of resources limits project development and collaboration with international peers.



**Figure 5 International collaboration reflected in the articles published in the Revista Facultad de Ingeniería.**

Using the option Citation Overview, available in SCOPUS, the first ten institutions of the authors citing the articles published in the Revista Facultad de Ingeniería, were separated by year of publication of the same articles (Figure 6). It can be observed that the authors of the Universidad Nacional de Colombia (UNAL-Colombia) have predominantly cited the articles of our journal published in 2013, 2015 and 2016. In 2014, the highest number of citations was by authors of Universidad de Antioquia (UDEA-Colombia). In addition to these universities, the Universidad del Valle (UNIVALLE-Colombia), el Centro de Investigación y de Estudios Avanzados del Instituto Politécnico Nacional (CINVESTAV-México), Universidade do Minho (UMINHO-Portugal), Universidad Politécnica de Madrid (UPM-España), Pontificia Universidad Javeriana (JAVERIANA-Colombia), Universidad de los Andes (UNIANDES-Colombia), Universidad Industrial de Santander (UIS-Colombia), Universidad Francisco de Paula Santander (UFPS-Colombia), Instituto Politécnico Nacional (IPN-Mexico), Universidad Distrital Francisco José de Caldas (UDISTRITAL-Colombia), Universidad Tecnológica de Pereira (UTP-Colombia), Universitat Politècnica de Catalunya (UPC-España), Universidad Simón Bolívar (UNISIMON-Venezuela), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET-Argentina), Consejo Superior de Investigaciones Científicas (CSIC-Spain), Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU-Germany), Universidad Autónoma Metropolitana (UAM-Mexico), Universidad del Cauca (UNICAUCA-Colombia), Universidad de Guanajuato (UGTO-Mexico), Escuela Politécnica de Ingeniería de Gijón (EPIGIJON-

Spain), Universidad Nacional Autónoma de México (UNAM-México), Universidad Cooperativa de Colombia (UCC-Colombia), Universidad de Medellín (UDEM-Colombia), Universidad de Castilla La-Mancha (UCLM-Spain), Ministry of Education China (MOE-China) and the Universidad Autónoma de Baja California (UABC-Mexico).



**Figure 6 Distribution of the affiliated institutions of the authors citing the articles published in the respective years in the Revista Facultad de Ingeniería Journal.**

## References

- Elsevier, *Scopus*. [Online]. Available: <https://www.scopus.com>. Accessed on: Aug. 11, 2017.
- Formación Universitaria, "SCImago," vol. 5, no. 5, 2012. [Online]. Available: [http://www.scielo.cl/scielo.php?script=sci\\_arttext&pid=S0718-50062012000500001](http://www.scielo.cl/scielo.php?script=sci_arttext&pid=S0718-50062012000500001). Accessed on: Aug. 13, 2017.
- Scimago Lab, *SJR Scimago Journal & Country Rank*. [Online]. Available: <http://www.scimagojr.com/>. Accessed on: Aug. 15, 2017.

Maryory Astrid Gómez Botero  
 Editor-in-Chief  
 Revista Facultad de Ingeniería  
 Professor-Universidad de Antioquia  
<https://orcid.org/0000-0001-9685-3080>