

## BIOGRAPHICAL DATA OF SERGEY G. ABAIMOV

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Researcher ID: R-4761-2016

### Education

***B.S. with honor***

Moscow Institute of Physics and Technology - State University,  
Moscow, Russia, 1994.

***M.S. with honor***

Moscow Institute of Physics and Technology - State University,  
Moscow, Russia, 1996.

***PhD***

University of California, Davis, 2008.

***Cand. Phys. Math. Sci.***

Russian Academy of Sciences, 2011.

### Title

***Docent in Theoretical Physics***

The Ministry of Education and Science of the Russian Federation, 2017.

### Positions Held

**2013-now**

Assistant Professor, Skolkovo Institute of Science and Technology.

**2010-2017 (on Saturdays)**

Associate Professor, Department of Theoretical Physics, Moscow  
Institute of Physics and Technology.

**2010-2013**

Structural Analyst (3<sup>rd</sup> skill level), Group manager, Team-lead of two projects, Progresstech/Boeing.

**2008-2009**

Postdoctoral Scholar, Department of Engineering Science and Mechanics, Pennsylvania State University, Pennsylvania, USA.

**1996-2005**

Engineering Manager (Head of Subdepartment), Rocket-Space Corporation “Energiya”, Korolev, Moscow region, Russia.

**1995-1996**

Researcher, N.N. Andreyev Acoustics Institute, Moscow, Russia.

**Awards**

Boeing’s Best Engineer, 2010.

One of eight laureates of S.P.Korolev’s Competition, Korolev, Russia, 2000.

Prize-winner (1st place) of XVth Science-Technology Conference, Korolev, Russia, 1999;

Student stipend of the Acoustical Society of America, 1996.

Winner (3rd place) of Physics-Mathematics Olympiad, Moscow Engineering Physics Institute, Moscow, 1990.

Winner (1st place) of Mathematics Olympiad “MSTU-90”, Moscow State Technical University n.a. N.E. Bauman (MSTU), Moscow, 1990.

Winner of National Competition “Abiturient-90” (Mathematics and Physics), Russia, 1990.

Winner of Physics-Mathematics Olympiad, Moscow Institute of Physics and Technology - State University, Moscow, 1989.

Silver Medal, Moscow Mathematical School 315, 1990.

**PhD theses**

Oleg V. Lebedev, *Study of deformational behavior of electrical conductivity of polymer composites with different nanofiller distribution types*, Material Science, Center for Design, Manufacturing and Materials, Skolkovo Institute of Science and Technology, Oct. 2020. (Adviser).

<https://www.skoltech.ru/en/education/phd-defenses/2020-2/oleg-lebedev/>

<https://www.skoltech.ru/app/data/uploads/2020/09/thesis2.pdf>

## Master theses

Nadezhda Kozlova (Povarnitsyna), *Theoretical study of the influence of porosity on the mechanical and physical properties of metals, ceramics, and composites*, Advanced Manufacturing and Materials, Center for Design, Manufacturing and Materials, Skolkovo Institute of Science and Technology, Jun. 2018 (Adviser).

Boris Voloskov, *Experimental analysis of mechanical behavior of additively manufactured stainless steel specimens*, Advanced Manufacturing and Materials, Center for Design, Manufacturing and Materials, Skolkovo Institute of Science and Technology, Jun. 2018 (Co-Adviser).

Hitesh Sharma, *Multiscale modeling of effects-of-defects onto structural performance of fiber reinforced polymer composites*, Advanced Manufacturing and Materials, Center for Design, Manufacturing and Materials, Skolkovo Institute of Science and Technology, Jun. 2018 (Co-Adviser).

Aleksei Shiverskii, *Experimental Studies of Electrical Conductivity of Graphene*, Advanced Manufacturing and Materials, Center for Design, Manufacturing and Materials, Skolkovo Institute of Science and Technology, Jun. 2019 (Adviser).

Victor Babarinde Oluseyi, *Interface Characterization of Glass Fiber-Polypropylene Matrix Composite*, Advanced Manufacturing and Materials, Center for Design, Manufacturing and Materials, Skolkovo Institute of Science and Technology, Jun. 2019 (Adviser).

Mahato Biltu, *Interface Characterization of Fiber Reinforced Polymer Composite in Mode II Loading*, Advanced Manufacturing and Materials, Center for Design, Manufacturing and Materials, Skolkovo Institute of Science and Technology, Jun. 2019 (Adviser).

Aleksandr Kukharskii, *Scaling and Correlation Phenomena of Fracture Surfaces*, Advanced Manufacturing Technologies, Center for Design, Manufacturing and Materials, Skolkovo Institute of Science and Technology, Jun. 2021 (Adviser).

## Patents

1. Russian patent application 2021132289 from Nov 8, 2021: Shiverskiy A.V., Abaimov S.G., Akhatov I.S., Technologies of manufacturing flexible and transparent electronic components based on graphene-like structures in polymer for electronics and microelectronics (Технологии получения гибких и прозрачных электронных компонентов на основе графеноподобных структур в полимере для электроники и микроэлектроники).

## Scholarships and Grants

2. Siemens, Postdoctoral Scholarship, 2008-2009.

3. RFBR (РФФИ) 94-02-03296, Investigation of propagation of waves of high intensity in multiphase non-uniform media (Исследование распространения волн высокой интенсивности в многофазных неоднородных средах), 1994.
4. RFBR (РФФИ) 96-02-16561-a, Acoustics of multiphase media (Акустика многофазных сред), 1996.
5. RFBR (РФФИ) 16-02-00660, Effect of Long Range Interaction on the Formation of Thermodynamic and Optical Properties for Various Physical Systems (Роль дальнего взаимодействия в формировании термодинамических и оптических свойств различных физических систем), 2016.
6. RFBR (РФФИ) (PI) 19-03-00369, Development of experimental and theoretical principles for design of electrically conductive nanocomposite materials with an extremely segregated structure and modeling of their architecture and properties (Разработка экспериментальных и теоретических принципов создания электропроводящих нанокomпозиционных материалов с предельно сегрегированной структурой и моделирование их пространственной структуры и свойств), 2019-2020, 2 mln.r.
7. Next Generation MIT-Skoltech (PI) 2020-2023, Multifunctional Fusion: Life-cycle enhancements via data-driven nanoengineering of advanced composite structures (Синтез мультифункциональностей: Поддержка жизненного цикла на основе цифрового нанoproектирования перспективных композитных конструкций), Skoltech 37.5 mln.r., MIT \$1.05 mln.

## Service

- ISO Standardization Committee TC 61/SC 13/WG 1, project ISO/WD 4410 “Experimental characterization of in-plane permeability of fibrous reinforcements for liquid composite moulding”.
- Associate Editor, Frontiers in Physics, since 2017.
- Topic Editor, MDPI Materials, since 2020.
- Reviewer of several journals.

## Featured in the News

1. [Press Release: Skoltech Researcher Publishes Monograph on the Application of Statistical Physics to Complex Non-Thermal Phenomenon](#) (Russian version: [Пресс-релиз: Научный сотрудник Сколтеха опубликовал монографию о применении статистической физики к сложным нетепловым явлениям](#)).
2. [Press Release: Scientists at Skoltech take a step forward in bringing carbon nanocomposites to practical industrial applications](#) (Russian version: [Ученые Сколтеха сделали новый шаг на пути к внедрению углеродных нанокomпозитов в промышленные приложения](#)).

## Books

1. Sergey G. Abaimov, *Statistical Physics of Complex Systems*, URSS, Moscow, 2012, pp. 388, ISBN 978-5-397-02309-2 (С.Г. Абаимов, Статистическая физика сложных систем, в серии Синергетика: от прошлого к будущему №57, УРСС-Либроком, Москва, 2012, стр. 388, ISBN 978-5-397-02309-2).
2. Sergey G. Abaimov, *Statistical Physics of Complex Systems*, stereotype ed., URSS, Moscow, 2013, pp. 388, ISBN 978-5-397-03872-0 (С.Г. Абаимов, Статистическая физика сложных систем, в серии Синергетика: от прошлого к будущему №57, УРСС, Москва, 2013, стр. 388, ISBN 978-5-397-03872-0).
3. Sergey G. Abaimov, *Statistical Physics of Complex Systems*, stereotype ed., URSS, Moscow, 2016, pp. 388, ISBN 978-5-397-05208-5 (С.Г. Абаимов, Статистическая физика сложных систем, в серии Синергетика: от прошлого к будущему №57, УРСС, Москва, 2016, стр. 388, ISBN 978-5-397-05208-5).
4. Sergey G. Abaimov, *Statistical Physics of Complex Systems*, stereotype ed., URSS, Moscow, 2016, pp. 388, ISBN 978-5-397-05207-8 (С.Г. Абаимов, Статистическая физика сложных систем, в серии Синергетика: от прошлого к будущему №57, УРСС, Москва, 2016, стр. 388, ISBN 978-5-397-05207-8).
5. Sergey Abaimov, *Statistical Physics of Non-Thermal Phase Transitions*, Springer, 2015.
6. I.G. Dezhina, A.K. Ponomarev, A.S. Frolov, D.N. Zorin, S.G. Psakhie, Zafer Gurdal, A.V. Azarov, S.G. Abaimov, M.V. Belov, I.V. Danilin, A.R. Efimov, N.G. Kurakova, V.G. Zinov, L.A. Tsvetkova, O.A. Eremchenko, *Public Analytical Report on "Advanced Manufacturing Technologies"*, Delo (RANERA), 2015, pp. 272, ISBN 978-5-7749-1064-9 (И.Г. Дежина, А.К. Пономарев, А.С. Фролов, Д.Н. Зорин, С.Г. Псахье, Зафер Гурдал, А.В. Азаров, С.Г. Абаимов, М.В. Белов, И.В. Данилин, А.Р. Ефимов, Н.Г. Куракова, В.Г. Зинов, Л.А. Цветкова, О.А. Еремченко, *Новые производственные технологии: публичный аналитический доклад*, Издательский дом "Дело" Российской академии народного хозяйства и государственной службы при Президенте Российской Федерации, Москва, 2015, стр. 272, ISBN 978-5-7749-1064-9).
7. K.I. Sipalo, A.K. Ponomarev, I.S. Akhatov, Fardad Azarmi, I.K. Uzhinsky, O.S. Aladyshev, G.E. Rudenskiy, P.S. Dorojkin, V.V. Klochkov, I.N. Vorobiev, A.V. Baranov, E.A. Kiselev, A.V. Bernsteyn, E.V. Burnaev, A.E. Ushakov, S.V. Dubinskiy, A.A. Safonov, M.A. Pogosova, S.P. Buyakova, Ya. Ye. Shahova, A.V. Panin, M.I. Lerner, V.V. Stupnikov, A.V. Pankov, I.V. Sergeichev, S.G. Abaimov, B.N. Fedulov, E.G. Mironov, D.O. Teteryukov, A.L. Pavlov, D.A. Gorin, E.S. Prokhozhenko, A.M. Yatshenok, N.A. Gryaznov, Yu.S. Skribina, A.V. Levchenko, D.I. Makarenko, S.V. Kovriga, Z.K. Avdeeva, *Perspective Technologies for Aircraft Industry: Analytical Survey*, Nauka, 2017, pp. 462, ISBN 978-5-02-040100-6 (К.И. Сыпало, А.К. Пономарев, И.Ш. Ахатов, Fardad Azarmi, И.К. Ужинский, О.С. Аладышев, Г.Е. Руденский, П.С. Дорожкин, В.В. Клочков, И.Н. Воробьев, А.В. Баранов, Е.А. Киселев, А.В.

- Бернштейн, Е.В. Бурнаев, А.Е. Ушаков, С.В. Дубинский, А.А. Сафонов, М.А. Погосова, С.П. Бужкова, Я.Э. Шахова, А.В. Панин, М.И. Лернер, В.В. Ступников, А.В. Панков, И.В. Сергеичев, С.Г. Абаимов, Б.Н. Федулов, Е.Г. Миронов, Д.О. Тетерюков, А.Л. Павлов, Д.А. Горин, Е.С. Прихожденко, А.М. Яценюк, Н.А. Грязнов, Ю.С. Скибина, А.В. Левченко, Д.И. Макаренко, С.В. Коврига, З.К. Авдеева, *Перспективные технологии для авиационной промышленности: Аналитический обзор*, Наука, Москва, стр. 462, ISBN 978-5-02-040100-6.
8. S.G. Abaimov, I.S. Akhatov, Y.M. Belousov, A.V. Mikheenko, I.Y. Poshchuk, *Entropy Growth in Analytical and Quantum Mechanics: Fundamentals of Mechanics*, URSS, Moscow, 2020, pp. 338, ISBN 978-5-9710-6649-1 (С.Г. Абаимов, И.Ш. Ахатов, Ю.М. Белоусов, А.В. Михеенков, И.Я. Полищук, *Рост энтропии в аналитической и квантовой механике: Фундаментальные основы механики*, УРСС-Ленанд, Москва, 2020, стр. 338, ISBN 978-5-9710-6649-1).

### Book chapters

1. D.L. Turcotte, S.G. Abaimov, R. Shcherbakov, and J.B. Rundle, Nonlinear dynamics of natural hazards, p. 557-580, in *Nonlinear Dynamics in Geosciences*, Springer, New York, 2007, ISBN 978-0-387-34917-6, e-ISBN 978-0-387-34918-3.
2. D.L. Turcotte, J.B. Rundle, M. Yoder, S.G. Abaimov, and W. Klein, Nucleation and critical phenomena, damage, and characteristic earthquakes, pp. 187-203, in *Acoustic Emission and Critical Phenomena: from Structural Mechanics to Geophysics*, eds. A. Carpinteri and G. Lacidogna, Taylor and Francis/Balkema, Leiden, 2008, ISBN 978-0-415-45082-9.
3. S.G. Abaimov, I.S. Akhatov, S.V. Lomov, Chapter 6. Detailed comparison of analytical and finite-element-based homogenization approaches for fibre-reinforced composites, pp. 141-177, in *Multi-Scale Continuum Mechanics Modelling of Fibre-Reinforced Polymer Composites*, ed. Wim Van Paeregem, vol. in Composites Science and Engineering series, Elsevier, Woodhead Publishing, 2020, ISBN 9780128189849, e-ISBN 9780128189856.

### Reviewed Publications

1. S.G. Abaimov and S.A. Rybak, Scattering of a plane wave at a sound pulse, *Acoust. Phys.*, **42**(2), 229, 1996 (С.Г. Абаимов, С.А. Рыбак, Рассеяние плоской волны на звуковом импульсе, *Акуст. ж.*, **42**(2), 262-263, 1996).
2. S.G. Abaimov and S.A. Rybak, Wave instabilities in the laminar boundary layer, *Acoust. Phys.*, **43**(5), 499, 1997 (С.Г. Абаимов, С.А. Рыбак, Волновые неустойчивости в ламинарном пограничном слое, *Акуст. ж.*, **43**(5), 581-585, 1997).

3. (Q2) S.G. Abaimov, D.L. Turcotte, R. Shcherbakov, J.B. Rundle, G. Yakovlev, C. Goltz, and W.I. Newman, Earthquakes: Recurrence and interoccurrence times, *Pure Ap. Geophys.*, **165**, 777-795, 2008, DOI 10.1007/978-3-7643-8757-0\_20.
4. (Q2) S.G. Abaimov, D.L. Turcotte, R. Shcherbakov, and J.B. Rundle, Recurrence and interoccurrence behavior of self-organized complex phenomena, *Nonlin. Proc. Geophys.*, **14**, 455-464, 2007, DOI 10.5194/npg-14-455-2007.
5. (Q1) S.G. Abaimov, D.L. Turcotte, and J.B. Rundle, Recurrence-time and frequency-slip statistics of slip events on the creeping section of the San Andreas fault in central California, *Geophys. J. Int.*, **170**, 1289-1299, 2007, DOI 10.1111/j.1365-246X.2007.03479.x.
6. (Q1) C. Goltz, D.L. Turcotte, S.G. Abaimov, R.M. Nadeau, N. Uchida, T. Matsuzawa, Rescaled earthquake recurrence time statistics: application to microrepeaters, *Geophys. J. Int.*, **176**, 256-264, 2009, DOI 10.1111/j.1365-246X.2008.03999.x.
7. (Q1) D.L. Turcotte, S.G. Abaimov, I. Dobson, J.B. Rundle, Implications of an inverse branching aftershock sequence model, *Phys. Rev. E*, **79**, 016101, 2009, DOI 10.1103/PhysRevE.79.016101.
8. (Q2) S.G. Abaimov, K.F. Tiampo, D.L. Turcotte, J.B. Rundle, Recurrent frequency-size distribution of characteristic events, *Nonlin. Proc. Geophys.*, **16**, 333-350, 2009, DOI 10.5194/npg-16-333-2009.
9. (Q2) S.G. Abaimov, Applicability and non-applicability of equilibrium statistical mechanics to non-thermal damage phenomena, *J. Stat. Mech.*, **P09005**, 2008, DOI 10.1088/1742-5468/2008/09/P09005.
10. S.G. Abaimov, Application of classical statistical mechanics to multifractals and dynamical systems, arXiv:**0805.0347**, 2008.
11. (Q2) S.G. Abaimov, Applicability and non-applicability of equilibrium statistical mechanics to non-thermal damage phenomena: II. Spinodal behavior, *J. Stat. Mech.*, **P03039**, 2009, DOI 10.1088/1742-5468/2009/03/P03039.
12. S.G. Abaimov, Critical behavior of slider-block model, arXiv:**0902.3767**, 2009.
13. S.G. Abaimov, Non-equilibrium statistical mechanics of non-equilibrium damage phenomena, arXiv:**0905.0292**, 2009.
14. S.G. Abaimov, General formalism of non-equilibrium statistical mechanics, a path approach, arXiv:**0906.0190**, 2009.
15. J. Cusumano, F. Costanzo, S. Abaimov in the text, The nature of predictability in systems with evolving damage, *Structural Health Monitoring*, **2**(1), 2010.
16. (Q2) M.R. Yoder, J.V. Aalsburg, D.L. Turcotte, S.G. Abaimov, J.B. Rundle, Statistical variability and Tokunaga branching of aftershock sequences utilizing

- BASS model simulations, *Pure Ap. Geoph.*, **170**(1-2), 155-171, 2013, DOI 10.1007/s00024-011-0411-2.
17. (Q1) S.G. Abaimov and J.P. Cusumano, Nucleation phenomena in an annealed damage model: Statistics of times to failure, *Phys. Rev. E*, **90**(6), 062401, 2014, DOI 10.1103/PhysRevE.90.062401.
  18. (Q1) S.G. Abaimov, A.A. Khudyakova, S.V. Lomov, On the closed form expression of the Mori-Tanaka theory prediction for the engineering constants of a unidirectional fiber-reinforced ply, *Compos. Struct.*, **142**, 1-6, 2016, DOI 10.1016/j.compstruct.2016.02.001.
  19. (Q1) S.G. Abaimov and I.S. Akhatov, Non-thermal quenched damage phenomena: The application of the mean-field approach for the three-dimensional case, *AIP Advan.*, **6**(9), 095116, 2016, DOI 10.1063/1.4963304.
  20. S.V. Dubinskiy, F.S. Sevastyanov, A.A. Safonov, S.G. Abaimov, N.V. Rozin, B.N. Fedulov, Evaluation of mechanical properties in vacuum infused structures with micro and macro voids, *Composit. Nanostruct.*, **8**(3), 151-159, 2016 (С.В. Дубинский, Ф.С. Севастьянов, А.А. Сафонов, С.Г. Абаймов, Н.В. Розин, Б.Н. Федулов, Метод расчетного определения прочностных свойств конструкций с учетом образования микро и макро пор при вакуумной инфузии, *Композиты и наноструктуры*, **8**(8), 151-159, 2016).
  21. (Q2) S.G. Abaimov, Non-equilibrium annealed damage phenomena: A path integral approach, *Front. in Phys.*, **5**, 6(1-16), 2017, DOI 10.3389/fphy.2017.00006.
  22. (Q1) V.I. Betekhtin, A.G. Kadomtsev, M.V. Narykova, M.V. Bannikov, S.G. Abaimov, I.Sh. Akhatov, T. Palin-Luc, and O.B. Naimark, Experimental and theoretical study of multiscale damage-failure transition in very high cycle fatigue, *Phys. Mesomech.*, **20**(1), 78-89, 2017, DOI 10.1134/S1029959917010076 (В.И. Бетехтин, А.Г. Кадомцев, М.В. Нарыкова, М.В. Банников, С.Г. Абаймов, И.Ш. Ахатов, Т. Palin-Luc, О.Б. Наймарк, Экспериментальное и теоретическое исследование многомасштабных закономерностей разрушения при сверхмногоцикловой усталости, *Физ. мезомех.*, **20**(1), 82-93, 2017).
  23. (Q1) A. Trofimov, S. Abaimov, I. Akhatov, I. Sevostianov, Effect of elastic contrast on the contribution of helical fibers into overall stiffness of a composites, *Int. J. Eng. Sci.*, **120**, 31-50, 2017, DOI 10.1016/j.ijengsci.2017.06.014.
  24. (Q1) A. Trofimov, S. Abaimov, I. Akhatov, I. Sevostianov, On the bounds of applicability of two-step homogenization technique for porous materials, *Int. J. Eng. Sci.*, **123**, 117-126, 2018, DOI 10.1016/j.ijengsci.2017.11.017.
  25. (Q1) I. Sevostianov, S.G. Abaimov, A. Trofimov, Replacement relations for thermal conductivities of heterogeneous materials having different matrices, *Mech. Mater.*, **121**, 50-56, 2018, DOI 10.1016/j.mechmat.2018.03.003.



26. (Q1) A. Trofimov, S. Abaimov, I. Sevostianov, Inverse homogenization problem: Evaluation of elastic and electrical (thermal) properties of composite constituents, *Int. J. Eng. Sci.*, **129**, 34-46, 2018, DOI 10.1016/j.ijengsci.2018.04.001.
27. (Q1) E. Popov, A. Trofimov, A. Goncharov, S. Abaimov, E. Chekhonin, Yu. Popov, I. Sevostianov, Technique of rock thermal conductivity evaluation on core cuttings and non-consolidated rocks, *Int. J. Rock Mech. Mining Sci.*, **108**, 15-22, 2018, DOI 10.1016/j.ijrmms.2018.05.005.
28. (Q1) A. Trofimov, A. Markov, S.G. Abaimov, I. Akhatov, I. Sevostianov, Overall elastic properties of a material containing inhomogeneities of concave shape, *Int. J. Eng. Sci.*, **132**, 30-44, 2018, DOI 10.1016/j.ijengsci.2018.07.004.
29. (Q1) A. Markov, S. Abaimov, I. Sevostianov, M. Kachanov, S. Kanaun, I. Akhatov, The effect of multiple contacts between crack faces on crack contribution to the effective elastic properties, *Int. J. Solids Struct.*, **163**, 75-86, 2019, DOI 10.1016/j.ijsolstr.2018.12.021.
30. (Q1) D. May, A. Aktas, S.G. Advani, D.C. Berg, A. Endruweit, E. Fauster, S.V. Lomov, A. Long, P. Mitschang, S. Abaimov, D. Abliz, I. Akhatov, M.A. Ali, T.D. Allen, S. Bickerton, M. Bodaghi, B. Caglar, H. Caglar, A. Chiminelli, N. Correia, B. Cosson, M. Danzi, J. Dittmann, P. Ermanni, G. Francucci, A. George, V. Grishaev, M. Hancioglu, M.A. Kabachi, K. Kind, M. Deléglise-Lagardère, M. Lasपालas, O.V. Lebedev, M. Lizaranzu, P.-J. Liotier, P. Middendorf, J. Morán, C.-H. Park, R.B. Pipes, M.F. Pucci, J. Raynal, E.S. Rodriguez, R. Schledjewski, R. Schubnel, N. Sharp, G. Sims, E.M. Sozer, P. Sousa, J. Thomas, R. Umer, W. Wijaya, B. Willenbacher, A. Yong, S. Zaremba, G. Ziegmann, In-plane permeability characterization of engineering textiles based on radial flow experiments: A benchmark exercise, *Composit. A*, **121**, 100-114, 2019, DOI 10.1016/j.compositesa.2019.03.006.
31. (Q1) S.G. Abaimov, A. Trofimov, I.V. Sergeichev, I.S. Akhatov, Multi-step homogenization in the Mori-Tanaka-Benveniste theory, *Composit. Struct.*, **223**, 110801, 2019, DOI 10.1016/j.compstruct.2019.03.073.
32. (Q1) O.V. Lebedev, A. Trofimov, S.G. Abaimov, A.N. Ozerin, Modeling of an effect of uniaxial deformation on electrical conductance of polypropylene-based composites filled with agglomerated nanoparticles, *Int. J. Eng. Sci.*, **144**, 103132, 2019, DOI 10.1016/j.ijengsci.2019.103132.
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### **Indexed Conference Papers**

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