SDI Review Form 1.6

Journal Name:	**British Journal of Mathematics & Computer Science**
Manuscript Number:	**2015_BJMCS_18555**
Title of the Manuscript:	**Design, Optimization and Fabrication of a Climbing Six Articulated-Wheeled Robot using Artificial Evolution and 3D Printing**
Type of the Article	**Original Research Article**

General guideline for Peer Review process:

This journal's peer review policy states that **NO** manuscript should be rejected only on the basis of '**lack of Novelty**', provided the manuscript is scientifically robust and technically sound.
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PART 1: Review Comments

	Reviewer's comment	**Author's comment** *(if agreed with reviewer, correct the manuscript and highlight that part in the manuscript. It is mandatory that authors should write his/her feedback here)*
Compulsory REVISION comments	**The writing style should be improved. There are several grammar errors and a few sentences that are difficult to read and understand.** **In the title of the paper, and along the paper, the authors mention that the robot they developed is a robot with climbing abilities. In robotics, when mentioning climbing robots means that these robots are capable of climbing through vertical (or almost vertical) surfaces. This is not the case. See, for instance, the following reference:** **Manuel F. Silva, J. A. Tenreiro Machado; A Survey of Technologies and Applications for Climbing Robots Locomotion and Adhesion; Climbing and Walking Robots. Behnam Miripour (Ed.). May 2010. INTECH. ISBN: 978-953-307-030-8. Available for download: http://sciyo.com/articles/show/title/a-survey-of-technologies-and-applications-for-climbing-robots-locomotion-and-adhesion. pp. 1–22.** **In this case the robot is just able to transverse obstacles.** **I recommend the authors to remove this mention on the text, since this can mislead the readers, or at least, explain clearly in the paper Introduction what they mean by "Climbing". This is just explained in Page 3, Lines 105 - 107.** **Page 2, Line 50 - Check the grammar of this sentence.**	Explanation on the "climbing ability" has been added. **Page 2, Line 50 – revised.** **Page 3, Line 95 – revised.** **Page 6, Line 170 – added in Section 3.1.** **Page 3, Line 104 – revised.** **Page 7, Line 189 – add units.** **Page 7, Line 191 – explanation added.** **Page 7, Lines 220 – 227 – added.** **Line 8, Lines 251 – 252 – Parents are randomly selected from archive where individuals in the archive are the non-dominated optimal solutions (best solutions).**

	Page 3, Line 95 - Consider rewriting this sentence. As it is, it is difficult to understand. The ideia is that each leg has 1 dof and the the range of each leg joint is 180º. **Page 3, Line 104: Change "rare" to "rear".** **Page 6, Line 170 - What simulator was used for testing the Evolutionary Algorithm solutions? What it a commercial one or one developed by the authors? This should be made clear to the readers.** **Page 7, Line 189 - What are the units of d? A distance?** **Page 7, Line 191 - How in the maximum number os collisions computed? How is it possible to determine this value? This is not clear to the reviewer.** **Page 7, Lines 220 - 227 - The authors should state what the minimum and maximum values for the parameters to be evolved are.** **Line 8, Lines 251 - 252 - In the reviewer opinion, the parent to be selected should not be randomly selected but selected between one of the previous best solutions, through the selection operator.** **Page 12, Line 352 - The population size of just one individual seems to me wrong. In the reviewer opinion, the authors should**	**Page 12, Line 352 – optimal solutions are able to be obtained with simple evolution with population size of one, its better than complicated way. However, reviewer's opinion will be taken into consideration for future work.** **Page 13, Line 397 – revised.** **Page 14, Line 409 – figure 11 is already showing the pareto-optimal solutions with size fitness and performance fitness.** **Page 15, Lines 438 – 440 – the evaluation is done by comparing the performance of real world SAWRs with the SAWRs evolved in the simulation. Higher score will be credited for those who can perform as perfect as in the simulation.** **Plagiarism issue: statement has been added in authors' contribution section.**

	work with a bigger population and should use other EA operators, such as the combination of parents - this is the basic operator in Genetic Algorithms. **Page 13, Line 397 - Figure 10 should have better graphical quality.** **Page 14, Line 409 - In the reviewer opinion, the chart with the Pareto optimal solutions, should be a 2D chart with one axis representing the Size Fitness (equation 5) and the other the Performance Fitness (equation 6).** **Page 15, Lines 438 - 440 - How is this performance evaluated?** **Plagiarism issue:** This paper is largely based on the following one: S. H. Lim and J. Teo; Integrating Evolutionary Robotics with 3D Printing for Rapid Fabrication and Deployment of a Physically-Simulated Autonomous Six Articulated-Wheeled Robot; Proceedings of the International Conference on Artificial Intelligence and Pattern Recognition, Kuala Lumpur, Malaysia, 2014; pp. 184 – 191. http://www.academia.edu/9346207/Integrating_Evolutionary_Robotics_with_3D_Printing_for_Rapid_Fabrication_and_Deployment_of_a_Physically-Simulated_Autonomous_Six_Articulated-Wheeled_Robot In my opinion, in case the paper is from the same authors it should bear a mention stating that it is an extended version of a previously published paper.	

Minor REVISION comments	Page 2, Lines 41 - 42: Consider include more references to the seminal works on this area. I suggest the following ones: Matsumoto, O., Kajita, S. and Komoriya, K., 2002, "Flexible Locomotion Control of a Self-Contained Biped Leg-Wheeled System," in Proceedings of the 2002 IEEE/RSJ International Conference on Intelligent Robots and Systems, Lausanne, Switzerland, September 30 – October 4, pp. 2599 – 2604. Matsumoto, O., Kajita, S., Saigo, M. and Tani, K., 1999, "Biped-Type Leg-Wheeled Robot," Advanced Robotics 13(3), 235 – 241. Ylönen, S. J. and Halme, A. J., 2002, "WorkPartner – Centaur Like Service Robot," in Proceedings of the 2002 IEEE/RSJ International Conference on Intelligent Robots and Systems, Lausanne, Switzerland, September 30 – October 4, pp. 727 – 732. Ota, Y., Yoneda, K., Tamaki, T. and Hirose, S., 2002, "A Walking and Wheeled Hybrid Locomotion With Twin-Frame Structure Robot," in Proceedings of the 2002 IEEE/RSJ International Conference on Intelligent Robots and Systems, Lausanne, Switzerland, September 30 – October 4, pp. 2645 – 2651. Hirose, S. and Takeuchi, H., 1996, "Study on Roller-Walker (Basic Characteristics and its Control)," in Proceedings of the 1996 IEEE International Conference on Robotics and Automation, Minneapolis, MN, USA, April 22 – 28, pp. 3265 – 3270. Endo, G. and Hirose, S., 2000, "Study on Roller-Walker (Multi-Mode Steering Control and Self-Contained Locomotion)," in Proceedings of the 2000 IEEE International Conference on Robotics and Automation, San Francisco, CA, USA, April 24 – 28, pp. 2808 – 2814. An excellent review of this topic is presented in the paper:	References added.

	Manuel F. Silva, J. A. Tenreiro Machado; A Literature Review on the Optimization of Legged Robots; Journal of Vibration and Control, Vol. 18, No. 12, October 2012; ISSN 1077-5463; pp. 1753 – 1767. Page 2, Lines 66 - 67 - There are already several references to this type of approach to robotics. See, for instance, the following references: C. Leger, DARWIN2K - An Evolutionary Approach to Automated Design for Robotics, Kluwer Academic Publishers, 2000. S. Nol, D. Floreano, Evolutionary Robotics - The Biology, Intelligence, and Technology of Self-Organizing Machines, The MIT Press, 2000. J. Jurez-Guerrero, Muoz-Gutirrez, W. W. M. Cuevas, Design of a walking machine structure using evolutionary strategies, in: Proc. of the IEEE Int. Conf. on Systems, Man and Cybernetics, 1998, pp. 1427.1432. A. Ishiguro, K. Kawasumi, A. Fujii, Increasing evolvability of a locomotion controller using a passivedynamic-walking embodiment, in: Proc. of the IEEE/RSJ Int. Conf. on Intel. Robots and Systems, 2002, pp. 2581.2586. H. Lipson, J. B. Pollack, Towards continuously recon-figurable self-designing robots, in: Proc. of the IEEE Int. Conf. on Rob. and Aut., 2000, pp. 1761.1766. K. Endo, F. Yamasaki, T. Maeno, H. Kitano, A method for co-evolving morphology and walking pattern of biped humanoid robot, in: Proc. of the IEEE Int. Conf. on Rob. and Aut., 2002, pp. 2775.2780. K. Endo, T. Maeno, H. Kitano, Co-evolution of morphology and walking pattern of biped humanoid robot using evolutionary computation - consideration of characteristic of the servomotors, in: Proc. of the IEEE/RSJ Int. Conf. on Intel. Robots and Systems, 2002, pp. 2678.2683.	

	K. Endo, T. Maeno, Co-evolution of morphology and walking pattern of biped humanoid robot using evolutionary computation - designing the real robot, in: Proc. of the IEEE Int. Conf. on Rob. and Aut., 2003, pp. 1362.1367. Manuel F. Silva, Ramiro S. Barbosa, J. A. Tenreiro Machado; Optimization of Hexapod Locomotion Using Genetic Algorithms; Proceedings of the Conference MIC 2010 – The 30th IASTED International Conference on Modelling, Identification and Control; 15 – 17 February 2010; Innsbruck, Austria; pp. 291 – 297. Page 5, Line 158 and Page 17, Line 482 - Consider changing the word "goodness" with another one. Page 6, Fig. 4 - Is there any particular reason for the authors to have just used the mutation operator in the Evolutionary Algorithms that they developed (either in SOEA and MOEA)? Why were not considered other operators such as crossover and spontaneous generation? Page 6, Line 182-183 - The authors should bear in mind that with this fitness function they will get small robots that can not traverse very difficult terrain. In the reviewer opinion, the fitness function should be able to generate robots with good terrain negotiation characteristics. Page 14, Line 411 - Why is not presented in Table 4 the size Fitness? It also seems obvious to the reviewer that as the wheel radius and leg length increase it is "easier" for the robot to transverse bigger obstacles.	Page 5, Line 158 and Page 17, Line 482 – revised. Page 6, Fig. 4 – our EA is most likely to EP approach that deals with numbers. Therefore no phenotype representation and no crossover operation in our EA. Page 6, Line 182-183 – our research scope is to obtain smallest possible robot with the ability to climb over obstacles. Page 14, Line 411 – size fitness is already shown in the table. Page 2, Lines 31 – 32 – it's a citation from previous published paper.

Optional/General comments	Page 2, Lines 31 - 32: The reviewer has serious reserves regarding the veracity of this statement.	