

Presentation of the paper “3D Visualization Techniques in Health Science Learning. Application case of Thermographic Images to Blood Flow Monitoring”

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Abstract

The present work proposes a new learning methodology based on the combination of geotechnologies for the acquisition of competence in the studies of physiotherapy and nursery. The approach is based on three-dimensional visualization techniques over thermographic images to improve the comprehension and interpretation of blood flow. The proposal is aimed to be applied in practical sessions of subjects of the area of knowledge of the Physiology, to demonstrate through the geotechnologies, the effect of the application of the changes of the flow blood. The present approach is related to the virtual laboratories field, since the generated virtual material can be used for acquisition of practical skills and competences, as well as evaluation of competencies in e-learning courses. The learning material is structured to be easily deployed in a learning management system, allowing the students to work with the models by means of open-source solutions without an additional effort.

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Keywords

Educational innovation; ICT; E-Learning; Engineering; Virtual laboratory; Circulatory physiology

Link to the presentation

https://figshare.com/articles/Untitled_Item/7379501/3

References

- [1] Ruben Heradio, Luis de la Torre, Daniel Galán, Francisco Javier Cabrerizo, Enrique Herrera-Viedma and Sebastian Dormido. 2016. Virtual and remote labs in education: a bibliometric analysis. *Computers & Education*, 98 (July 2016), 14–38. DOI: <https://doi.org/10.1016/j.compedu.2016.03.010>
- [2] Veljko Potkonjak, Michael Gardner, Victor Callaghan, Pasi Mattila, Christian Guetl, Vladimir Petrović and Kosta Jovanović. 2016. Virtual laboratories for education in science, technology, and engineering: A review. *Computers & Education*, 95 (April 2016), 309-327. DOI: <https://doi.org/10.1016/j.compedu.2016.02.002>
- [3] Pablo Rodríguez-González and Manuel Rodríguez-Martín. 2018. Aproximaciones geomáticas para la generación de materiales docentes para laboratorios virtuales en ingeniería. In *Proceedings of the IV Congreso internacional sobre innovación pedagógica y praxis educativa (INNOVAGOGIA 2018)*. AFOE Formación. Sevilla, Spain, 306.
- [4] Manuel Rodríguez-Martín and Pablo Rodríguez-González. 2018. Learning based on 3D photogrammetry models to evaluate the competences in visual testing of welds. In *Proceedings of the 2018 IEEE Global Engineering Education Conference*. IEEE. Santa Cruz de Tenerife, Spain, 1582-1587. DOI: <https://doi.org/10.1109/EDUCON.2018.8363422>
- [5] Edward Francis J. Ring and Kurt Ammer. 2012. Infrared thermal imaging in medicine. *Physiological measurement*, 33, 3, R33-R46. DOI: <https://dx.doi.org/10.1088/0967-3334/33/3/R33>
- [6] Edward Francis J. Ring and Jonathan M. Dicks. 1999. Spatial resolution of new thermal imaging systems. *Thermology International*, 19, 7-14.
- [7] Mie Jin Lim, Seong Ryul Kwon, Kyong-Hee Jung, Kwoon Joo, Shin-Goo Park and Won Park. 2014. Digital thermography of the fingers and toes in Raynaud's phenomenon. *Journal of Korean medical science*, 29, 4, 502-506. DOI: <http://dx.doi.org/10.3346/jkms.2014.29.4.50>
- [8] Ariane L. Herrick and Andrea Murray. 2018. The role of capillaroscopy and thermography in the assessment and management of Raynaud's phenomenon. *Autoimmunity Reviews*, 17, 5, 465-472. DOI: <https://doi.org/10.1016/j.autrev.2017.11.036>
- [9] Dennis Dam Soerensen and Lene Juul Pedersen. 2015. Infrared skin temperature measurements for monitoring health in pigs: a review. *Acta veterinaria scandinavica*, 57, 5, 11 pages. DOI: <https://doi.org/10.1186/s13028-015-0094-2>
- [10] John M. Johnson and Duane W. Proppe. 2011. Cardiovascular adjustments to heat stress. *Comprehensive Physiology*, Supplement 14: Handbook of Physiology, Environmental Physiology, 215-243. DOI: <https://doi.org/10.1002/cphy.cp040111>
- [11] Nisha Charkoudian. 2010. Mechanisms and modifiers of reflex induced cutaneous vasodilation and vasoconstriction in humans. *Journal of Applied Physiology*, 109, 1221-1228. DOI: <https://doi.org/10.1152/jappphysiol.00298.2010>

- [12] Knut Schmidt-Nielsen. 1997. *Animal physiology - adaptation and environment*. Cambridge University Press, New York
- [13] Stuart Clark, Fiona Campbell, Tonia Moore, Malcolm I.V. Jayson, Terence A. King, and Ariane L. Herrick. 1999. Laser doppler imaging—a new technique for quantifying microcirculatory flow in patients with primary Raynaud's phenomenon and systemic sclerosis. *Microvascular Research*, 57, 3, 284–291. DOI: <https://doi.org/10.1006/mvre.1998.2124>
- [14] Oliver Schlager, Michael E. Gschwandtner, Karin Herberg, Tanja Frohner, Martin Schillinger, Renate Koppensteiner and Wolfgang Mlekusch. 2010. Correlation of infrared thermography and skin perfusion in Raynaud patients and in healthy controls. *Microvascular Research*, 80, 1 (July 2010), 54-57. DOI: <https://doi.org/10.1016/j.mvr.2010.01.010>
- [15] Antoine Jullien. 1935. *Travaux pratiques de physiologie et principes d'expérimentation*. Baillière et Fils, Paris
- [16] Walter Bradford Cannon. 1929. *Curso de fisiología de laboratorio (1st ed. Spanish)*. D. Appleton and Company, New York
- [17] Ildelfonso Alvear-Ordenes. 2017. Consolidación de una práctica integradora en fisiología humana. *Infancia, Educación y Aprendizaje (IEYA)*, 3, 2, 429-433. DOI: <http://dx.doi.org/10.22370/ieya.2017.3.2.760>
- [18] Pablo Rodríguez-González, Simón Cardozo Mamani, Ángel Guerra Campo, Luis Javier Sánchez-Aparicio, Susana del Pozo, Ángel Luis Muñoz-Nieto and Diego González-Aguilera. 2018. Diachronic reconstruction of lost cultural heritage sites. Study case of the medieval wall of Avila (Spain). *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLII-2, 975-981. DOI: <https://doi.org/10.5194/isprs-archives-XLII-2-975-2018>
- [19] Ellen Keenan, Georgina Gethin, Louisa Flynn, David Watterson and Gerard M. O'Connor. 2017. Enhanced thermal imaging of wound tissue for better clinical decision making. *Physiological measurement*, 38, 6 (May 2017), 1104-1115. DOI: <https://doi.org/10.1088/1361-6579/aa6ea0>
- [20] Yanpeng Cao, Baobei Xu, Zhangyu Ye, Jiangxin Yang, Yanlong Cao, Christel-Loic Tisse and Xin Li. 2018. Depth and thermal sensor fusion to enhance 3D thermographic reconstruction. *Optics Express*, 26, 7 (April 2018), 8179-8193. DOI: <https://doi.org/10.1364/OE.26.00819>
- [21] Chih-Hsiao Tsai, Yin-Hao Kuo, Kuo-Chung Chu and Jung-Chuan Yen. 2015. Development and Evaluation of Game-Based Learning System Using the Microsoft Kinect Sensor. *International Journal of Distributed Sensor Networks*, 11, 7 (July 2015), 1-10. DOI: <https://doi.org/10.1155/2015/498560>
- [22] CloudCompare. 2018. CloudCompare Version 2.9.1. [GPL software]. Retrieved May 25, 2018 from <http://www.cloudcompare.org/>
- [23] Paolo Cignoni, Marco Callieri, Massimiliano Corsini, Matteo Dellepiane, Fabio Ganovelli and Guido Ranzuglia. 2008. Meshlab: an open-source mesh processing tool. In *Proceedings of the Eurographics Italian Chapter Conference*, Salerno, Italy, 1-8.

[24] Diego Vergara, Manuel Rodríguez-Martín, Manuel Pablo Rubio, Jesús Ferrer, Francisco Javier Nuñez and Luisa Moralejo. 2018. Formación de personal técnico en ensayos no destructivos por ultrasonidos mediante realidad virtual. *DYNA Ingeniería e industria*, 93, 2 (March 2018), 150-154, DOI: <http://dx.doi.org/10.6036/8444>

[25] Pablo Rodríguez González, Ángel Luis Muñoz Nieto, Vanessa Izquierdo Álvarez, Fernando Almaraz Menéndez and Benjamín Arias Pérez. 2017. Virtualización del máster en geotecnologías cartográficas en ingeniería y arquitectura. In *Proceedings of the V Congreso Internacional de Docencia Universitaria (CINDU)*, Vigo, Spain. 173-177.