

Luís Correia  
Luís Paulo Reis  
José Cascalho  
Luís Mendes Gomes  
Hélia Guerra  
Pedro Cardoso (Eds.)

## **ADVANCES IN ARTIFICIAL INTELLIGENCE \_ LOCAL PROCEEDINGS**

EPIA 2013 \_ XVI Portuguese Conference on Artificial Intelligence  
Angra do Heroísmo, Azores, Portugal, 9 -12 September



Opinions in User Reviews: An Evaluation of Sentiment Analysis Techniques .....	468
<i>Filipa Peleja and João Magalhães</i>	
Density-Based Graph Model for Multi-Document Summarization .....	480
<i>Mohammadreza Valizadeh and Pavel Brazdil</i>	
BioTextRetriever: yet another Information Retrieval system .....	492
<i>Célia Talma Gonçalves, Rui Camacho and Eugénio Oliveira</i>	
<b>Doctoral Symposium on Artificial Intelligence (SDIA)</b>	
Incremental and Hierarchical Document Clustering .....	506
<i>Rui Encarnação and Paulo Gomes</i>	
Implementing Tabled Abduction in Logic Programs .....	518
<i>Ari Saptawijaya and Luís Moniz Pereira</i>	
Features Selection for Human Activity Recognition with iPhone Inertial Sensors .....	530
<i>Nuno Cruz-Silva, João Mendes-Moreira and Paulo Menezes</i>	
An artificial empathetic entity: the interaction impact on humans .....	541
<i>Nuno A. C. Henriques</i>	
Applying the Measurement Logic Machine to Multi-Agent Iterated Games .....	549
<i>José Ferreira de Castro</i>	
<b>Challenges Regular Contributions</b>	
A Philosophical View on Artificial Intelligence .....	562
<i>Helder Coelho</i>	
Heraclito: a Dialectical Tutor for Logic .....	570
<i>João C. Gluz, Fabiane Pentead, Marcel Mossmann, Lucas Gomes, Rosa Vicari</i>	
Automation of Species Identification and Description .....	573
<i>Pedro Cardoso, Rui Carvalho, João Carreira and Jorge Batista</i>	
Biodiversity Data Compilation .....	576
<i>Pedro Cardoso, Luís Mendes Gomes</i>	
Cluster analysis optimization .....	578
<i>Pedro Cardoso, Francois Rigal, Armando Mendes</i>	
PAT2Math: an ITS for Algebraic Problem-Solving .....	580
<i>Patricia A. Jaques, Henrique Seffrin, Geiseane Rubi, Felipe de Moraes, Cassio Guilardi</i>	

Automation of Organelle Identification in Developing Maize Endosperm Transfer Cells .....	582
<i>Paulo Monjardino, Sara Rocha, Pedro Cardoso</i>	
Challenges in assessing color and spatial distribution of bacterial mats in lava cavities .....	584
<i>Cristina Riquelme, Pedro Cardoso, Francois Rigal, Maria de Lurdes Enes Dapkevicius</i>	

Ar  
Stu  
Mu  
Ar  
Ap  
em  
Ou  
Sm  
Pay  
On  
Ar  
An  
Hu  
An  
Pro  
Dy  
Cor  
Evo

## Challenges in assessing color and spatial distribution of bacterial mats in lava cavities

Cristina Riquelme<sup>1</sup>, Pedro Cardoso<sup>2,3</sup>, François Rigal<sup>3</sup> & Maria de Lurdes Enes Dapkevicus<sup>1</sup>

<sup>1</sup> Food Technology Group (CITA-A), University of the Azores, Angra do Heroísmo, Portugal.

<sup>2</sup> Finnish Museum of Natural History, University of Helsinki, Finland.

<sup>3</sup> Azorean Biodiversity Group (CITA-A) and Portuguese Platform for Enhancing Ecological Research & Sustainability (PEERS), University of the Azores, Angra do Heroísmo, Portugal.

`gabrielcristinar@uac.pt`, `pedro.cardoso@helsinki.fi`,  
`rigal@uac.pt`, `mariaenes@uac.pt`

Microorganisms that live in extreme environments, such as volcanic cavities, often opt for a biofilm lifestyle to enhance their survival possibilities [1, 2]. Cave-dwelling microbial biofilms (bacterial mats) are functionally complex ecosystems, comprehending several evolutionarily distant bacterial phylotypes [3, 4, 5]. Bacterial mats are important not only because of their role in cave ecology, but they have also been demonstrated to hold promise as potential sources for industrially valuable compounds, such as antibiotics [6, 7]. Bacterial mats form colorful patches on the walls and ceilings of caves. Their colors range from white, or gray to tan, several shades of yellow and sometimes pink [3]. Recent studies suggest differences between mat colors, both at structural [8] and bacterial consortium composition levels [9, 10, 11]. Little is still known on the spatial distribution of the differently colored mats and its representation in caves, but the available data, obtained in carbonate caves, seem to indicate that each type of community is housed in different ecological niches, where the influx of organic matter and microclimatic parameters vary [8, 12]. It would be important to elucidate spatial distribution of the colored mats in volcanic cavities as well, in order to gain a better understanding of the ecology of these subterranean extreme environments. This poses several challenges. Consistent visual evaluation of mat color, on itself, is subjective and assessing the degree of coverage by each mat color is difficult. Microbial mats sometimes juxtapose, making this task even harder. Instrumental, objective methods are lacking that could help with the task of determining which microbial mats grow where in volcanic cavities.

Color pattern recognition is an old topic with much recent development, partly due to the extensive use of photo-editing software. This task has been accomplished in many ways, but is usually optimal only with evenly lit subjects in controlled environments. A cave environment, with uneven walls covered by different bacterial mats in varying concentration, leading to very different hue and saturation of similar mats, represents a real challenge for any algorithm intending to properly separate and quantify the surface covered by such mats. Developing either supervised or unsupervised classification systems that can handle dozens or hundreds of bacterial mat pictures in a batch process may be a difficult task and prompts the following questions:

Automation of Organelle Identification in Developing Maize Endosperm Transfer Cells .....	582
<i>Paulo Monjardino, Sara Rocha, Pedro Cardoso</i>	
Challenges in assessing color and spatial distribution of bacterial mats in lava cavities .....	584
<i>Cristina Riquelme, Pedro Cardoso, Francois Rigal, Maria de Lurdes Enes Dapkevicius</i>	

Ar  
Stu  
Mu  
Ar  
Ap  
em  
Ou  
Sm  
Pay  
On  
Ar  
An  
Hu  
An  
Pro  
Dy  
Cor  
Evo