

Proceedings

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on Complex, Intelligent, and
Software Intensive Systems**

CISIS 2013

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Edited by:

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CISIS 2013

Table of Contents

Message from CISIS 2013 General Co-Chairs.....	xvi
Message from CISIS 2013 Program Committee Co-Chairs.....	xviii
Message from CISIS 2013 Workshops Co-Chairs.....	xix
CISIS 2013 Organizing Committee.....	xx
CISIS 2013 Reviewers.....	xxxiii
CISIS 2013 Keynote Abstracts.....	xxxiv
Welcome Message from ACCORD 2013 International Workshop Co-Chairs.....	xxxvii
ACCORD 2013 Organizing Committee.....	xxxviii
ACCORD 2013 Reviewers.....	xxxix
Welcome Message from ALICE-2013 Workshop Chairs.....	xl
ALICE-2013 Organizing Committee.....	xli
ALICE-2013 Reviewers.....	xlii
Message from ECDS 2013 International Workshop Organizers.....	xliii
ECDS 2013 Organizing Committee.....	xliv
ECDS 2013 Reviewers.....	xlvi
Welcome Message from ePaMus 2013 International Workshop Organizers.....	xlvi
ePaMus-2013 Organizing Committee.....	xlvii
ePaMus-2013 Reviewers.....	xlviix
Welcome Message from HCCIEA-2013 International Workshop Co-Chairs.....	l
HCCIEA-2013 Organizing Committee.....	li
HCCIEA-2013 Reviewers.....	lii
Message from ICAS 2013 International Workshop Co-Chairs.....	liii
ICAS 2013 Organizing Committee.....	liv
ICAS 2013 Reviewers.....	lv
Welcome Message from ICLS 2013 International Workshop Organizers.....	lvi
ICLS 2013 Organizing Committee.....	lvii
ICLS 2013 Reviewers.....	lviii
Welcome Message from IIBM-2013 International Workshop Co-Chairs.....	lvix
IIBM-2013 Organizing Committee.....	lx
IIBM-2013 Reviewers.....	lxii
Welcome Message from the IIHCI-2013 Workshop Organizers.....	lxiii
IIHCI-2013 Organizing Committee.....	lxiv

IIHCI-2013 Reviewers.....	lxv
Welcome Message from ISCT 2013 International Workshop Co-Chairs.....	lxvi
ISCT-2013 Organizing Committee and Reviewers.....	lxvii
Welcome Message from SEIMTH 2013 International Workshop Co-Chairs.....	lxviii
SEIMTH-2013 Organizing Committee.....	lxix
SEIMTH-2013 Reviewers.....	lxx
Message from VENOA-2013 International Workshop Organizers.....	lxxi
VENOA-2013 Organizing Committee.....	lxxii
VENOA-2013 Reviewers.....	lxxiii

The Seventh International Conference on Complex, Intelligent, and Software Intensive Systems (CISIS 2013)

Session 1: Ad-Hoc and Cognitive Radio Networks

Evaluation of Cognitive Wireless Based Delay Tolerant Network for Disaster Information System in a Rural Area.....	1
<i>Noriki Uchida, Noritaka Kawamura, and Yoshitaka Shibata</i>	
Performance Comparison of OLSR with ETX_Float and ETX_ff in a MANET Testbed.....	8
<i>Masahiro Hiyama, Elis Kulla, Makoto Ikeda, Leonard Barolli, and Makoto Takizawa</i>	
Waiting Probability Analysis for Dynamic Spectrum Access in Cognitive Radio Networks.....	15
<i>Danda B. Rawat, Bhed B. Bista, Sachin Shetty, and Gongjun Yan</i>	
Effect of AODV HELLO Packets for Different Mobility Degrees.....	21
<i>Elis Kulla, Masahiro Hiyama, Makoto Ikeda, Leonard Barolli, Fatos Xhafa, and Makoto Takizawa</i>	

Session 2: Web and Internet Computing

Predicting Student Academic Performance.....	27
<i>Kin Fun Li, David Rusk, and Fred Song</i>	
Current Trends in Emotional e-Learning: New Perspectives for Enhancing Emotional Intelligence.....	34
<i>Thanasis Daradoumis, Marta Arguedas, and Fatos Xhafa</i>	
Digital Collaboration Network for SMEs: Awareness of ICT and Perceived Outcome.....	40
<i>Olivia Fachrunnisa, Mutamimah, and Gunawan</i>	

Session 3: Vehicular and Sensor Networks

Performance Evaluation of OLSR Protocol in a Grid Manhattan VANET Scenario for Different Applications.....	47
<i>Evjola Spaho, Makoto Ikeda, Leonard Barolli, Fatos Xhafa, Vladi Kolic, and Makoto Takizawa</i>	
Performance Analysis of Wireless Sensor Networks for Different Speeds of Sink and Sensor Nodes.....	53
<i>Tao Yang, Elis Kulla, Leonard Barolli, Gjergji Mino, and Makoto Takizawa</i>	
An IVC Broadcast Scheme Based on Traffic Phase for Emergency Message Dissemination at Road Intersection.....	59
<i>Guozhen Tan, Yong Yin, Junling Bu, and Nan Ding</i>	
Allocation of Sensor Nodes Or Base Stations in Inhomogeneous Propagation Environments.....	66
<i>Jun-Hyuck Lee, Masafumi Takematsu, Kazunori Uchida, and Junichi Honda</i>	

Session 4: Cloud and Cluster

An Architecture for Parallelizing Fully Homomorphic Cryptography on Cloud	72
<i>Ryan Hayward and Chia-Chu Chiang</i>	
A Cloud-Based Framework to Enhance Augmented Reality	78
<i>Chung-Ting Kao, Kai-Yuan (Kevin) Jan, and Rick C.S. Chen</i>	
Dynamic Clusters of Servers to Reduce Total Power Consumption	83
<i>Takuro Inoue, Ailixier Aikebaier, Tomoya Enokido, and Makoto Takizawa</i>	
The Evaluation of the Improved Redundant Power Consumption Laxity-Based (IRPCLB) Algorithm in Homogeneous and Heterogeneous Clusters	91
<i>Tomoya Enokido, Ailixier Aikebaier, and Makoto Takizawa</i>	

Session 5: Fuzzy-Based Systems

A Fuzzy Clustering Approach for Determination of Ideal Points of New Products	99
<i>Kit Yan Chan</i>	
An Integrated Fuzzy Logic System for Cluster-Head Selection and Sensor Speed Control in WSNs	104
<i>Qi Wang, Elis Kulla, Gjergji Mino, Leonard Barolli, and Jiro Iwashige</i>	
A Fuzzy-Based System to Evaluate the Peer Reliability in JXTA-Overlay P2P	111
<i>Kouhei Umezaki, Eyjola Spaho, Leonard Barolli, Fatos Xhafa, Valbona Barolli, and Jiro Iwashige</i>	
Developing Mobile Intelligent System for Cattle Disease Diagnosis and First Aid Action Suggestion	117
<i>Wiwik Anggraeni, A. Muklason, A.F. Ashari, A. Wahyu, and Darminto</i>	

Session 6: Multimedia Systems

Personalising Multi Video Streams and Camera Views for Live Events	122
<i>Zhenchen Wang</i>	
A Specialized Architecture for Color Image Edge Detection Based on Clifford Algebra	128
<i>Silvia Franchini, Antonio Gentile, Giorgio Vassallo, Filippo Sorbello, and Salvatore Vitabile</i>	
Telerehabilitation Using Low-Cost Video Game Controllers	136
<i>Kin Fun Li, Ana-Maria Sevcenco, and Elaine Yan</i>	
Twitter Sentiment Mining: A Multi Domain Analysis	144
<i>Saeideh Shahheidari, Hai Dong, and Md Nor Ridzuan Bin Daud</i>	

Session 7: Mesh Networks

Performance Evaluation of WMN-GA System for Node Placement in WMNs for Normal and Uniform Distributions of Mesh Clients Considering Different Grid Shapes	150
<i>Tetsuya Oda, Admir Barolli, Eyjola Spaho, Leonard Barolli, and Fatos Xhafa</i>	
Analysis of WMN-GA Simulation Results: WMN Performance Optimizing the Number of Mesh Routers	157
<i>Makoto Ikeda, Taiki Honda, Tetsuya Oda, Shinji Sakamoto, Xinyue Chang, and Leonard Barolli</i>	
Performance Analysis of WMNs Using Simulated Annealing Algorithm for Different Temperature Values	164
<i>Shinji Sakamoto, Tetsuya Oda, Elis Kulla, Makoto Ikeda, Leonard Barolli, and Fatos Xhafa</i>	
Performance Evaluation of WMN-GA System for Node Placement in WMNs Considering Exponential and Weibull Distribution of Mesh Clients and Different Selection and Mutation Operators	169
<i>Admir Barolli, Tetsuya Oda, Leonard Barolli, Fatos Xhafa, Makoto Takizawa, and Petraq Papajorgji</i>	

Session 8: Medical Applications

A Semi-automatic Multi-seed Region-Growing Approach for Uterine Fibroids Segmentation in MRgFUS Treatment	176
<i>Carmelo Militello, Salvatore Vitabile, Giorgio Russo, Giuliana Candiano, Cesare Gagliardo, Massimo Midiri, and Maria Carla Gilardi</i>	
Developing a Self-Health Management System of Arterial Elasticity Based on Smart Phone	183
<i>Ching-Chuan Wei and Yan-Zun Huang</i>	
The Design of Tunable Low Level Laser Stimulator	186
<i>Zhong Zheng, Zhan-Chang Yuan, Chang-Wei Hsieh, Pei-Xuan Lin, and Chi-Wen Lung</i>	
Simulate Human Visual Perception Using Expert Neurons	189
<i>Horatiu Sachelarie</i>	

Session 9: Telecommunication Systems

Reversible Difference Expansion Embedding Using Two Edge Directions	197
<i>Wen-Chuan Wu, Wei-Teng Wong, and Zi-Wei Lin</i>	
Diffraction Fields by the Edge of Wedge and Reflected Fields from Surface of Wedge	201
<i>Saki Kameyama, Jiro Iwashige, Motohiko Iwaida, and Yuki Isayama</i>	
A Method for Finding Diffraction Points on Two Edges with Arbitrary Angle and Its Diffraction Fields	207
<i>Motohiko Iwaida, Jiro Iwashige, Saki Kameyama, and Ryo Nagao</i>	
Estimation of Path Loss in Urban Areas Based on 1-Ray Model Using Building Coverage and Floor Area Ratios	213
<i>Keisuke Shigetomi, Masafumi Takematsu, Kazunori Uchida, and Junichi Honda</i>	

Session 10: Trust Management

RECLAMO: Virtual and Collaborative Honeynets Based on Trust Management and Autonomous Systems Applied to Intrusion Management	219
<i>Manuel Gil Pérez, Verónica Mateos Lanchas, David Fernández Cambronero, Gregorio Martínez Pérez, and Victor A. Villagrà</i>	
Trust Management of Health Care Information in Social Networks	228
<i>Pawat Chomphosang, Yefeng Ruan, Arjan Durrresi, Mimoza Durrresi, and Leonard Barolli</i>	
An Advanced Technique for User Identification Using Partial Fingerprint	236
<i>V. Conti, G. Vitello, F. Sorbello, and S. Vitabile</i>	

Session 11: Data Storage and Scheduling

Towards an Efficacious Storage Performance in Virtualised Environment	243
<i>Ahmed A. Faris, Mohamed A. Shrud, and Ahmad H. Kharaz</i>	
Split File Model for Big Data in Low Throughput Storage	250
<i>Minoru Uehara</i>	
Grammar-Based Matching of Multiple Continuous Queries on XML Streams	257
<i>Chien-Ping Chou and Kuen-Fang Jea</i>	
Using STK Toolkit for Evaluating a GA Base Algorithm for Ground Station Scheduling	265
<i>Fatos Xhafa, Xavier Herrero, Admir Barolli, and Makoto Takizawa</i>	

Session 12: Mobile and Wireless Networks

Group-Based Control Method for Machine Type Communications in LTE System	274
<i>Feng-Ming Yang, Chun-Yen Hsu, and Wen-Chien Hung</i>	
A Fast SA Update Mechanism for Secure SIP/IMS Mobility in Integrated UMTS-WLAN Networks	281
<i>Shih-Yuan Cheng and Whai-En Chen</i>	
A Oneself Adjusts Backoff Mechanism for Channel Access in IEEE 802.11 DCF WLAN	287
<i>Ming-Hwa Cheng, Wen-Shyang Hwang, Cheng-Han Lin, and Hui-Kai Su</i>	
A DTN Routing Protocol Based on Mobility and Maximum Number of Replications	293
<i>Kenta Henmi and Akio Koyama</i>	

Session 13: Secure Systems

Self-Authentication Mechanism with Recovery Ability for Digital Images	299
<i>Yi-Hui Chen, Chih-Yang Lin, and Wanutchaporn Sirakriengkrai</i>	
Security Analysis of a Protocol Based on Multiagents Systems for Clinical Data Exchange	305
<i>Albert Brugués de la Torre, Magí Lluch-Ariet, and Josep Pegueroles-Vallés</i>	
The TAMESIS Project: Enabling Technologies for the Health Status Monitoring and Secure Exchange of Clinical Record	312
<i>Josep Pegueroles, Luis J. de la Cruz, Juan Vera-del-Campo, Juan Hernández-Serrano, and Olga León</i>	

International Workshop on Advances in Cooperative COmmunications, Relaying, and Distributed MIMO (ACCORD 2013)

Session 1: Protocols and Algorithms for Cooperative Wireless Relay Networks

A Total Adaptive Power Allocation for Physical Layer Network Coding in Wireless Networks	320
<i>Yung-Fa Huang, Tan-Hsu Tan, Shi-Yan Peng, and Chia-Hsin Cheng</i>	
A Cooperative Bit-Map Routing Protocol in Ad Hoc Networks	325
<i>Hsing-Chung Chen, Neng-Yih Shih, Rizki Noviyanto, and Jui-Chi Chen</i>	
Downlink Relay Selection Algorithm for Amplify-and-Forward Cooperative Communication Systems	331
<i>Cheng-Ying Yang, Yi-Shan Lin, and Min-Shiang Hwang</i>	
A Four-Layers Hierarchical Clustering Topology Architecture with Sleep Mode in a Wireless Sensor Network	335
<i>Young-Long Chen, Yi-Nung Shih, and Jia-Sheng Lin</i>	

Session 2: Innovative Cooperative Communication Technologies

Using Back Propagation Neural Network for Channel Estimation and Compensation in OFDM Systems	340
<i>Chia-Hsin Cheng, Yung-Pei Cheng, Yung-Pei Cheng, and Wen-Ching</i>	
The Optimal Strategy of Direct/Cooperative Transmission in WLANs	346
<i>Chien-Erh Weng, Lie Yang, Chien-Hsuan Chen, and Jyh-Horng Wen</i>	
Application of Space-Time Coding in a Two-Hop Amplify-and-Forward Cooperative Network	351
<i>Chung-Hua Chiang, Yung-Cheng Yao, and Jyh-Horng Wen</i>	
Power Allocation for Multi-relay Amplify-and-Forward Cooperative OFDM	356
<i>Shu-Hong Lee, Yi-Yin Lin, Yung-Cheng Yao, and Jyh-Horng Wen</i>	

The Third International Workshop on Adaptive Learning via Interactive, Collaborative and Emotional Approaches (ALICE 2013)

Session 1: Adaptive and Collaborative Learning

Management of Latent Learning Needs in Adaptive e-Learning Systems	361
<i>Nicola Capuano, Saverio Salerno, Giuseppina Rita Mangione, and Anna Pierri</i>	
Engaging e-learning for Risk Management: The ALICE Experience in Italian Schools	367
<i>Nicola Capuano, Giuseppina Rita Mangione, Anna Pierri, and Eric Lin</i>	
Prototyping a Cognitive Assessment System to Enrich the Virtualization of Collaborative Learning	373
<i>Santi Caballé, Nestor Mora, Thanasis Daradoumis, David Gañan, Ian Dunwell, and Anna Pierri</i>	
Information Security in Support for Mobile Collaborative Learning	379
<i>Jorge Miguel, Santi Caballé, and Josep Prieto</i>	

Session 2: Emotion Awareness and Personalized e-Learning

Opinion Mining on Educational Resources at the Open University of Catalonia	385
<i>Isabel Guitart, Jordi Conesa, Luis Villarejo, Àgata Lapedriza, David Masip, Antoni Pérez, and Elena Planas</i>	
Measuring the Impact of Emotion Awareness on e-learning Situations	391
<i>Michalis Feidakis, Thanasis Daradoumis, Santi Caballé, and Jordi Conesa</i>	
A Case Study on the Influence of Emotions on Students' and Instructors' Marks	397
<i>Ruth Cobos, Pilar Rodríguez, and Álvaro Ortigosa</i>	
Measuring Empathy to Support Learning Design and Narrative Game: A Phenomenological Approach	401
<i>Giuseppina Rita Mangione, Tiziana Discepolo, Pio Alfredo Di Tore, Stefano Di Tore, Carla Cozzarelli, and Felice Corona</i>	
A Network Analysis Method for Selecting Personalized Content in e-Learning Programs	407
<i>Luis Casillas, Thanasis Daradoumis, and Santi Caballé</i>	

The Seventh International Workshop on Engineering Complex Distributed Systems (ECDS 2013)

Session 1: Distributed Systems and Applications

Reduction of Processing Overhead to Synchronize Multimedia Replicas	412
<i>Ailixier Aikebaier, Tomoya Enokido, and Makoto Takizawa</i>	
Requirements for Resilient Information and Communication Technology	418
<i>Shoichi Senda, Kien Nguyen, and Shigeki Yamada</i>	
Performance Analysis of WMNs Using Hill Climbing Algorithm Considering Normal and Uniform Distribution of Mesh Clients	424
<i>Xinyue Chang, Tetsuya Oda, Evjola Spaho, Makoto Ikeda, Leonard Barolli, and Fatos Xhafa</i>	
A Scalable Group Communication Protocol on P2P Overlay Networks	428
<i>Dilawaer Duolikun, Ailixier Aikebaier, Tomoya Enokido, and Makoto Takizawa</i>	
A Hybrid Method of User Privacy Protection for Location Based Services	434
<i>Kenta Miura and Fumiaki Sato</i>	

The Sixth International Workshop on Engineering Parallel and Multi-core Systems (ePaMus 2013)

Session 1: Real-Time Systems

Run-Time Monitoring Mechanism for Efficient Design of Application-Specific NoC Architectures in Multi/Manycore Era	440
<i>Akram Ben Ahmed, Takayuki Ochi, Shohei Miura, and Abderazek Ben Abdallah</i>	
Real-Time Object Detection for Multi-Camera on Heterogeneous Parallel Processing Systems	446
<i>Chih-Sheng Lin, Shih-Meng Teng, Yen-Ting Chen, and Pao-Ann Hsiung</i>	
An Efficient Task Placement Method for Reconfigurable FPGA Systems	451
<i>Trong-Yen Lee, Nian-You Lin, Wei-Cheng Chen, and Haixia Wu</i>	

Session 2: Engineering Parallel and Multi-core Systems

Hyper-Universal Switch Network for FPIC Design	456
<i>Mao-Hsu Yen, Chu Yu, Yih-Hsia Lin, and Chang-Hsien Chung</i>	
Low Complexity Digit-Serial Multiplier over GF(2 ^m) Using Karatsuba Technology	461
<i>Trong-Yen Lee, Min-Jea Liu, Chia-Chen Fan, Chia-Chun Tsai, and Haixia Wu</i>	
The Architecture of Parallelized Cloud-Based Automatic Testing System	467
<i>Chorng-Shiuh Koong, Chih-Hsiong Shih, Chang-Chung Wu, and Pao-Ann Hsiung</i>	

The Second International Workshop on Hybrid Cloud Computing Infrastructure for E-Science application (HCCIEA 2013)

Session 1: Hybrid/Cloud Computing Infrastructure for e-Science Application

Evolution Feature Oriented Model Driven Product Line Engineering Approach for Synergistic and Dynamic Service Evolution in Clouds: Pattern Data Structure	471
<i>Zhe Wang</i>	
Data as a Service (DaaS) for Sharing and Processing of Large Data Collections in the Cloud	475
<i>Olivier Terzo, Pietro Ruiu, Enrico Bucci, and Fatos Xhafa</i>	
e-Clouds: Scientific Computing as a Service	481
<i>David Méndez, Mario Villamiaz, and Harold Castro</i>	
GNSS Based Services on Cloud Environment	487
<i>L. Mossucca, L. Spogli, G. Caragnano, V. Romano, O. Terzo, G. De Franceschi, L. Alfonsi, and E. Plakidis</i>	

The Third International Workshop on Intelligent Context-Aware Systems (ICAS 2013)

Session 1: Advances in the Design and Application of Context-Aware Systems

Situational Awareness for Enhanced Patient Management	493
<i>Philip Moore, Andrew Thomas, George Tadros, Leonard Barolli, and Hai V. Pham</i>	
Emotive Sensors for Intelligent Care Systems: A Heuristic Discussion of Autonomic Wireless Sensing Systems	499
<i>A.M. Thomas, P. Moore, C. Evans, M. Sharma, P. Chima, V.C. Vijay, and S. Abu Rmeileh</i>	
A Multimodal Emotion-Focused e-health Monitoring Support System	505
<i>Jing Chen, Bin Hu, Na Li, Chengsheng Mao, and Philip Moore</i>	

Session 2: Application of Context-Aware Systems

Towards an iMAS Model Ontology: An Intelligent Mobile Advertising Service	511
<i>Cain Evans, Jagdev Bhogal, and Salameh Abu Rmeileh</i>	
The Application of Intelligent Context-Aware Systems to the Detection of Online Student Cheating	517
<i>Thomas Lancaster</i>	
Situated Computing and Virtual Learning Environments: e-Learning and the Benefits to the Students Learning	523
<i>Ron Austin, Mak Sharma, Philip Moore, and David Newell</i>	

The Second International Workshop on Intelligent Computing In Large-Scale Systems (ICLS 2013)

Session 1: Large-Scale Systems

Using Modularity Metrics to Assist Move Method Refactoring of Large Systems	529
<i>Christian Napoli, Giuseppe Pappalardo, and Emiliano Tramontana</i>	
Exploiting GPUs to Simulate Complex Systems	535
<i>Fabrizio Messina, Giuseppe Pappalardo, and Corrado Santoro</i>	
Controlling Distributed Systems Using Parallel Autonomic Managers	541
<i>M. Di Sano, A. Di Stefano, G. Morana, and D. Zito</i>	
Automated Conformance Testing of Java Virtual Machines	547
<i>Andrea Calvagna and Emiliano Tramontana</i>	

The Sixth International Workshop on Intelligent Informatics in Biology and Medicine (IIBM 2013)

Session 1: Intelligent Informatics

Network Completion for Time Varying Genetic Networks	553
<i>Natsu Nakajima and Tatsuya Akutsu</i>	
Power-Saving Encoding Schemes for Wireless ECG Signal Transmissions	559
<i>Hsiao-Chiu Chu</i>	
Discovering Feedback and Coupled Feedback Loops in KEGG Pathways through Cross-Map Identification	565
<i>Chen-Lung Liu, Chien-Ming Chen, Hui-Huang Hsu, and Tun-Wen Pai</i>	
Mining Polymorphic SSRs from Individual Genome Sequences	570
<i>Yu-Lun Lu, Chien-Ming Chen, Tun-Wen Pai, and Hao-Teng Chang</i>	
In Vitro Characterization and in Vivo Application of a Dual Functional Peptide	576
<i>Chien-Jung Chen, Ping-Hsueh Kuo, Ta-Jen Hung, Shun-Lung Fang, Che-Chuan Yang, Shieh-Yueh Yang, and Margaret Dah-Tsyr Chang</i>	

The Sixth International Workshop on Intelligent Interfaces For Human-Computer Interaction (IHCi 2013)

Session 1: Intelligent Interfaces

Visualization of Character's Intentions in Dramatic Media	582
<i>Vincenzo Lombardo, Rossana Damiano, Antonio Lieto, and Antonio Pizzo</i>	
Distraction User Interface for Repetitive Motor Tasks: A Pilot Study	588
<i>Giacinto Barresi, Dario Mazzanti, Darwin Caldwell, and Andrea Brogni</i>	

A Survey of Recent Advancement in Prospective Memory Support Systems	594
<i>Mauro Migliardi and Alberto Servetti</i>	

Advanced Interaction in Mixed Environments

An Evaluation of HCI and CMC in Information Systems within Highly Crowded Large Events	600
<i>Stefano Boca, Antonio Gentile, Stefano Ruggieri, and Salvatore Sorce</i>	
Gestures vs. Gesticulations: Change Point Models Based Segmentation for Natural Interactions	605
<i>Emmanuel Bernier, Ryad Chellali, and Indira Mouttapa Thouvenin</i>	
eLaparo4D: A Step Towards a Physical Training Space for Virtual Video Laparoscopic Surgery	611
<i>Marco Gaudina, Victor Zappi, Edoardo Bellanti, and Gianni Vercelli</i>	

International Workshop on Intelligent Services with Communication Technologies (ISCT 2013)

Session 1: Intelligent Services

A Sensor-Based Tracking System for Cyclist Group	617
<i>Haw-Yun Shin, Fok-Leong Un, and Kuo-Wei Huang</i>	
Genetic Algorithm-Based 3D Coverage Research in Wireless Sensor Networks	623
<i>Lin Feng, Zhenlong Sun, and Tie Qiu</i>	
The Graph Painting Mobile Game	629
<i>Ching-I Hsin and I-Hsuan Peng</i>	

Session 2: Network Services and Applications

Research on Task Allocation Strategy and Scheduling Algorithm of Multi-core Load Balance	634
<i>Chao Wu, Yifu Wang, Aoyang Zhao, and Tie Qiu</i>	
Implementation of Indoor VOC Air Pollution Monitoring System with Sensor Network	639
<i>I-Hsuan Peng, Yen-Yin Chu, Cui-Yu Kong, and Yu-Sheng Su</i>	
Improvement of Streaming Video in Differential Service Networks by Using Opportunity RED Mechanism	644
<i>I-Hsuan Peng, Meng-Hsien Lin, Yen-Wen Chen, Fong-Ming Yang, and Addison Y.S. Su</i>	

International Workshop on Sustainable Education and Information Management in Tourism and Hospitality (SEIMTH 2013)

Session 1: Social Responsible Tourism

The Cognition of Climate Change and Green Hotel	649
<i>Feng-En Lo, Kuan-Ting Lin, Ko Lu Ma, and Hsien-Yu Hsia</i>	
An Empirical Study on the Antecedents of Socially Responsible Consumption Behavior	654
<i>Chia-Ju Lu</i>	
An Exploratory Study of Corporate Social Responsibility of Travel Agency Websites and Consumers' Low Carbon Travel Intention	661
<i>Ma Chunjou and Sharon F.H. Pang</i>	

Session 2: Strategic Development of Tourism and Hospitality Industry

Balanced Scorecard in Hospitality	667
<i>Shu-Chuan Liu and Chung-Hao Chen</i>	
Exploration of Destination Competitiveness Framework—City as a Destination	673
<i>Hsi-Peng Tseng and Chung-Hao Chen</i>	
Understanding Pet Attachment and Happiness Linkages: The Mediating Role of Leisure Coping	677
<i>Ta-Wei Tang, Chien-Chao Chen, and Jung-Chi Chou</i>	

Session 3: Multi-disciplined Issues Related to Rural Tourism and Tourism Education

The Relationship Between Nature Experiential Activities and Multiple Intelligences Development with Autism Children	683
<i>Chiou-Shya Torng</i>	
Constructing the Supporting Service, Education Guidance, Management System of Network Education and Examination	688
<i>Xiaoyan Liu and Yu Mei</i>	
A Sport Capital Model to Explain Life Quality in Taiwan’s Rural Communities	693
<i>Li-Shiue Gau</i>	
The Effect of Experiential Agriculture Activities on the Tourism Image of Foreign Tourists to Dai-Dai Recreational Agriculture Area in Taiwan	698
<i>Chiou-Shya Torng and Jiun-Jie Jang</i>	

The Fifth International Workshop on Virtual Environment and Network-Oriented Applications (VENOA 2013)

Session 1: Innovative Applications I

Development of Hands-on IP Network Practice System with Automatic Scoring Function	704
<i>Nobukazu Iguchi and Yuki Kitazawa</i>	
Design of NFC Based Micro-payment to Support MD Authentication and Privacy for Trade Safety in NFC Applications	710
<i>Byungrae Cha and Jongwon Kim</i>	
A Modified Active Access-Point Selection Algorithm Considering Link Speed Change in IEEE 802.11n for Wireless Mesh Networks	714
<i>Nobuo Funabiki, Sho Fujita, Toru Nakanishi, and Kan Watanabe</i>	
Analyzing Text-Based User Feedback in e-Government Services Using Topic Models	720
<i>Dahlan Nariman</i>	

Session 2: Virtual Reality and Multimedia

Automatic 3D Furniture Layout Based on Interactive Evolutionary Computation	726
<i>Ryuya Akase and Yoshihiro Okada</i>	
Development of a WiFi Users’ Information Indicating System with AR	732
<i>Kenzi Watanabe, Masatoshi Imai, Hisaharu Tanaka, and Makoto Otani</i>	

Building of Japanese Emotion Ontology from Knowledge on the Web for Realistic Interactive CG Characters	735
<i>Kosuke Kaneko and Yoshihiro Okada</i>	
A Document Browser Based on a Book-Style Interface with Augmented Reality	741
<i>Masatoshi Nishimura, Tsuneo Kagawa, Hiroaki Nishino, and Kouichi Utsumiya</i>	
Session 3: Innovative Applications II	
An Integrated Distributed Log Management System with Metadata for Network Operation	747
<i>Minoru Ikebe and Kazuyuki Yoshida</i>	
A Study on Pseudo-Haptics by Cursor Moving with Motion Blur	751
<i>Masahiro Fukushima, Tsuyoshi Takemoto, and Makoto Fujimura</i>	
A Method of LFSR Seed Generation for Scan-Based BIST Using Constrained ATPG	755
<i>Takanori Moriyasu and Satoshi Ohtake</i>	
Study and Practice on Information Technology in an Educational Field Using a Cloud Service and SNS	760
<i>Ritsuko Watanabe, Hiroyuki Ehara, and Eiji Aoki</i>	
A Sonification Method for Medical Images to Support Diagnostic Imaging	766
<i>Tsuneo Kagawa, Shuichi Tanoue, Hiro Kiyosue, Hiromu Mori, and Hiroaki Nishino</i>	
Author Index	772

Visualization of character's intentions in dramatic media

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Abstract—The representation of characters' intentions in a story is of great importance for media scholars and analysts, and it is susceptible of applicative scenarios within the media industry. In this paper, we introduce an interactive system for the visualization of a story analysis based on a plan-based representation of the characters' intentions. The system relies on an ontology of drama and builds upon the unrestricted annotation provided by narrative enthusiasts and media students. The system is able to build the mapping between a library of plans and the users' annotation, and to visualize the contributions of the several characters' intentions to the whole plot. The system was tested on the analysis of a short movie.

I. INTRODUCTION

There exist a variety of areas of creativity that concern events unfolding over time and occurring in some space. All these areas usually benefit from a narrative mapping, i.e. a visualization of the events through a combination of "information graphics, journalistic diagramming, visualizations, reconstructions, and some conventional-looking (but ambitious) geographic maps" [1]. The aim is towards a representation of the event structure, with the possibility of carrying out analyses for specific aspects of the narrative. The result is the creation of an information space where the bits and pieces of some endeavor find an appropriate place in some structure and the design of novel interfaces for the exploration of such a space. For example, Narratives [2] is a system for viewing temporally-changing data based on keyword visualization, working with a corpus of blog entries that talk about news stories. The visualization relies upon a line graph, with users that can interact to see what additional concepts are most associated with a selected term. In other approaches, the aim is the generation of stories. Narrative theatre [3] is a tool for supporting the creation of fables. It relies on a computational framework that leverages the knowledge about the writing domain in order to reason about the events and create a visual representation of each event. It mostly focuses on the creation of storyboards from the written text.

This paper presents a tool for improving the didactics about the dramatic media through a visualization of the content of a media object. In particular, we focus on the visualization of the analysis of the characters' intentions (represented by plans) as a result of the interpretation of the actions in

an audiovisual fragment. Dramatic media [4] typically involve a narration based on the live action of characters in conflict. Linear audiovisuals involve a timeline along which the dramatic incidents unfold, supported by the characters' motivations. These motivations, called intentions and pursued through plans, are usually arranged on a tree, with component plans or action as children of some node representing a wider and longer standing plan. Therefore, the challenges posed by our visualization problem concern the display of a timeline, with a fixed order of the component of incidents, and the superimposition of trees that represent the characters' intentions. However, incidents and plans should be aligned to reveal the structure of motivations at the base of the incident unfolding in the plot.

Tree layout, especially in the case of multiple trees spanning the same set of basic elements (usually the leaves of a tree) has been the object of several approaches of information visualization (see the survey in [5] on single and multiple trees). Node-link, nested squares or circles, horizontal and vertical adjacency, indented-list, and matrix representations are well known in the literature, each with specific advantages and disadvantages, depending on the task at hand. For example, containment (or nested) approaches have the advantage of a bounded space but leave no room for node content visualization. Some work [6] has also addressed the problem of stitching together hierarchical structure and time into one visualization space, in order to help an analyst understand how very large hierarchies change through time; the goal is to enable the analyst to detect patterns of relationships. In our case, the interest is in the visualization of multiple trees that span the same frontier. In particular, here we refer to the timeline of incidents that occur in a narrative plot (leaf nodes of a tree), that result from the projection of the characters' plans (internal nodes). Since, the several characters' intentions are hierarchically organized into overlapping trees the necessity of multiple tree visualization arises.

The structure of the paper is the following. In the next section we sketch the computational ontology Drammar that represents the facts about drama (what concepts are to be included, what are the relations among the concepts, how we can build an ontology for a specific drama, i.e. the annotation of a dramatic media object). Then, we also introduce in detail

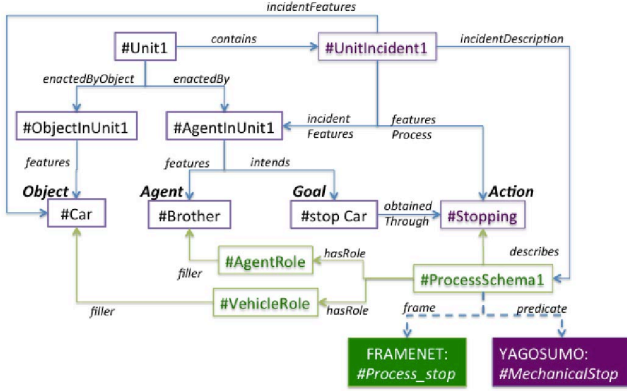


Fig. 1. The annotation of the incident where Brother stops Car, with instances of the ontological classes Unit, Entity (Agent and Object), Goal, Incident, Action (Process), and references to the external ontology YagoSumo and the linguistic resource Framenet.

the specific modeling issues related to actions and plans, and the timeline concepts of the elements that actually appear in the audiovisual fragment, and how they are mapped one on the other in order to build a useful visualization. The core of the paper consists of the visualization tool, that provides an interactive exploration of the characters' intentions and their mapping on the timeline incidents. Finally, we provide a preliminary, qualitative evaluation of the tool in the didactics of dramatic media analysis, and discuss the results. Conclusions end the paper.

II. DRAMA ONTOLOGY AND ANNOTATION

In this section we introduce the Drammar ontology and the annotation schema employed in project CADMOS through an example (see [7] for details). The ontology describes the content and structure of a story in terms of Units (the segments of a story), Entities (i.e., Agents and Objects involved in the story actions), and Relations (action structures relating the entities one another), generalizing over the specific format by which it is expressed (short movie, novel, screenplay, etc.) and the medium through which it is conveyed. The ontology refers to large-scale semantic resources for the description of the commonsense knowledge: the two upper ontologies Suggested Upper Merged Ontology (SUMO, [8]) and Yet Another Great Ontology (YAGO [9]), merged into YAGO-SUMO [10], which provide very detailed information about millions of situations, including entities (agents and objects), processes/actions, and events, and FrameNet [11], describing situations, processes/actions, and/or events through a semantic template that depicts the situation in terms of roles played by the elements which participate in it.

We describe the annotation of a story incident (see Figure 1), driven by the Time Indexed Situation design pattern developed in the descriptive ontology DOLCE [12]. This incident is extracted from the short movie “Exit strategy”, originally produced for project CADMOS, to evaluate the consequences of a semantic annotation onto the production methods. This

“noir” story concerns a group of three people, Brother, Sister, and (Sister’s) Girlfriend, who are going (by car) to spend a weekend in the country villa of Brother and Sister’s parents. The car trip draws attention to the arrogant attitude of Brother, who also plays a bad joke to an unlucky Man, asking for help because of his broken truck. Figure 1 shows the representation of the incident in which Brother stops the car, to play a joke to the Man (see below). The unit, called #Unit1, features two entities (via the #incidentFeatures property), the agent #Brother and the object #Car. The Unit contains a UnitIncident #UnitIncident1, which features (via the featuresProcess property) a stopping action/process #Stopping and an Agent (#Brother, through the AgentInUnit class), who intends to achieve the goal of #stopCar. An action is an ontological structure relying on the schema provided by DOLCE over processes, consisting of instances of action prototypes (process schemata), connected to action participants as filler of roles within the prototype structure (roles and filler constraints) provided by FrameNet. In our example, #ProcessSchema1, connected to the FrameNet frame Process_stop, binds the Brother to the filler of the #AgentRole and Car as the filler of the #VehicleRole. Finally, the annotation also includes the intention of Brother to “stop the car” (#stop Car, an instance of the Goal class) (see below for specifics of goals and intentions) is obtainedThrough the action of #Stopping, that is connected to the YAGOSUMO commonsense concept Mechanical Stop. In [13] we present the validation of the platform through a preliminary test with annotators.

In a dramatic medium, the incidents are arranged on a timeline,

$$+_{i=1}^N A_i$$

Some incident is to be motivated by the achievement of some goal, that is functional to the story advancement. A library of plans, associated with some agent, provides an association of goals and actions (that become actual incidents then) Here, we introduce the plans and the action structure, involving the states that hold before and after an action occurs.

A base plan

$$P[Goal] = +_{i=1}^M (PreConditions(A_i) A_i Effects(A_i))$$

is a sequence of actions (A_i) and states ($PreConditions(A_i)$ and $Effects(A_i)$), where the states are ontological structures similar to actions, ruled by state schemata and connected to participants (+ is the concatenation operator). States can be the pre-conditions and the effects of the actions.

Actions can also be plans themselves; so plans are recursively defined as sequences of (sub)plans and states.

$$P[Goal] = +_{i=1}^M (PreConditions(P_i) P_i Effects(P_i))$$

Pre-conditions can only be mental states, i.e. goals and beliefs. So, given the example of the test, in the short movie “Exit Strategy”, there is a scene in which a man, standing near a truck emitting smoke on the wayside, asks people passing by for stopping to help. The base plan identified by the annotator is that the man in stopping people by to ask for help in fixing the truck. The root plan consists of a maintenance goal of

going back to work after fixing the truck with the help of somebody who is stopping at him.

The base plan P_{b1}^{Man} has the form:

$P_{b1}^{Man}[G : \text{Man wants engage Driver for(Help)}] =$
 $B : \text{Man believes [SOA : Truck broken]}$
 $G : \text{Man wants [SOA : Man engaged Driver]}$
 $A : \text{Man askingHelp Driver}$
 $SOA : \text{Man confident}$

$SOA : \text{Driver in_motion near(Man)}$
 $A : \text{Driver stopping_byMan}$
 $B : \text{Man believes [SOA : Man engaged Driver]}$

In this description, the expressions such as “Man engage Driver for(Help)” are short for a ProcessSchema concerning “engage” and connected to a frame in which the participants are the person who engages (Man), the person who is engaged (Driver) and the reason of the engagement (Help). Also, notice that, in this convention, goals (G) require the verb “wants” followed by an action/state with the verb in a neuter form (engage); believes (B) always requires “believes” as verb connecting some agent and the state of affairs believed; state of affairs (SOA) require a past participle (“broken”) or an adjective (“confident”) applied to some entity; finally, actions are conventionally represented with a verb in the gerund form (“askingHelp”).

A higher level plan P_{r11}^{Man} , that includes the base plan P_{b1}^{Man} is:

$P_{r11}^{Man}[PG : \text{Man wants repair Truck}] =$
 $SOA : \text{Truck broken}$
 $P_{b1}^{Man}[AG : \text{Man wants engage Driver for(Help)}]$
 $SOA : \text{Man engaged Driver}$

$SOA : \text{Truck broken}$
 $SOA : \text{Man engaged Driver}$
 $P_{b2}^{Man}[PG : \text{Man, Driver wants fix Truck}]$
 $B : \text{Man, Driver believes [SOA : Truck fixed]}$
 $SOA : \text{Truck fixed}$

In the next section, we show how to augment the timeline representation of incidents to include the mapping between the plan actions and the incidents, in order to provide the input for the joint visualization of timelines and plans.

sectionAugmentation of the Timeline Representation

The aim is to build an intelligent system for establishing a mapping between the actions reported by the plans and the incidents of the timeline and augmenting the timeline with the states that hold between adjacent units, as projected from the plan structure. We have three goals in mind

- through the analysis of the plans, we discover the actions (contained in the plan representation) that match (i.e., motivate) the incidents of the timeline; this is useful for establishing the spatial alignment of the timeline incidents and the plan actions);
- point out successes and failures of characters’ behaviors: some plan actions are actually executed (as timeline incidents) and contribute to the plan success, some plan actions can be not executed and the plan fails to accomplish;
- project the states required by the plan, as preconditions or effects of the plan actions, onto the timeline in the places

preceding or following the incidents in order to motivate the story advancement through the story states.

In order to implement the intelligent system, we 1) model the timeline and the plans into the ontology, 2) define the incident mapping through SWRL IF–THEN rules, and 3) augment the timeline with states through an off–line algorithm.

Both timeline and plan modeling relies on the generic class *OrderedList*, that represent the positions of the incidents (and actions, respectively) on an ordered list. So, the Timeline class and the Plan class are *OrderedList*’s. An instance of Process or State refers to some position (relation *refersToTimeline*) in the Timeline or in a Plan, respectively.

Based on the representation above, the reasoner infers that some ordered list of incidents in the timeline belongs to some plan (actually, it can happen that some incident is mapped onto more than one plan). The reasoner works with inferences of an ontological nature (for example, the Driver class is a subclass of a PassingByPerson class) and with a SWRL IF–THEN rule that validates the mapping of some incident to some plan action: in particular, the rule tells that, given an incident I in the Timeline and an action A in the plan P,

if
 $I.ProcessSchema = A.ProcessSchema \ \&$
 $Role/Filler \ relations \ for \ I \ and \ A \ coincide$
then
 $I \ sameAs \ A.$

A similar rule is applied to states. The implementation of the mapping through ontological inferences (such as the subclass relation applied above), supported by the language OWL2 or, in some cases, manually encoded into SWRL IF–THEN rules is an innovative aspect of this work.

Finally, the augmentation of the timeline is implemented through an off–line algorithm that takes as inputs the timeline, the plans, and the incident mapping, and returns as output an *OrderedList* that contains the incidents of the Timeline, in the same partial order as in the Timeline, interspersed with states (agglomerated into story states) that respect the same partial as reported in the plans. So, if a (plan)state S is a precondition of the action A in the plan P, and the action A is mapped the incident I in the Timeline, then a state S’, that is the same as S is inserted in the Timeline before I (and after the incident preceding I in the Timeline). The augmented timeline *OrderedList* features a total order over incidents and states.

Now we see a brief example of the modeling of plans and timeline. In particular, we see how an incident can be mapped onto two actions of two different plans, respectively. This represents a misunderstanding in an audiovisual fictional tale. In this example, a Man, realizing his Truck is broken, asks the drivers passing by for help. Brother, who is driving by, pretends to be willing to help him by stopping his car, but as soon as the Man checks Brother’s will to help, Brother accelerates and departs, thus playing a joke to the Man.

The timeline (check the middle section of figure 2) contains four incidents: the first three are originated by agents’ actions, the fourth is an event (I_05_2: Girlfriend awakening in(Car)). The three actional incidents are:

- I_03: Man asking_help
- I_04: Brother stopping Car
- I_05_1: Brother leaving with(Car)

We have two plans. One is the plan P_{b5}^{Man} , which collapses two of the plans above for simplicity of exposition:

$P_{b1}^{Man}[AG : Man\ fix\ Truck\ with(Driver)] =$
B : Man believes [SOA : Truck broken]
G : Man wants [SOA : Man engaged Driver]
A : Man askingHelp Driver
SOA : Man confident

SOA : Driver in_motion near(Man)
A : Driver stopping Car
B : Man believes [SOA : Man engaged Driver]

SOA : Driver willing
A : Man, Driver fixing Truck
SOA : Truck fixed

The other plan concerns the Brother, $P_{b2}^{Brother}$:
 $P_{b2}^{Brother}[PG : Brother\ making_joke\ to(Man)\ with(Car)] =$

B : Brother believes [SOA : Truck broken]
A : Brother stopping Car
SOA : Car stopped

B : Brother believes [SOA : Man victim]
A : Brother leaving with(Car)
B : Man believes [SOA : Brother unwilling]

The incident/action mappings are the following. The incident “I_03: Man asking_help” is mapped onto the action *askingHelp(Man, Driver)*: in this case, the action description adds the receiver of the asking action, namely the Driver, to establish the sameAs relation; the incident “I_04: Brother stopping Car” is mapped onto the action *stopping(Driver, Car)*, thus equalizing Brother and Driver; finally, “I_05_1: Brother leaving with(Car)” is immediately mapped onto *Brother leaving with(Car)*. Notice that in this example we are using instantiated actions, with variables already replaced by the actual instances that are used in the mapping. The use of generalized actions, which is certainly advisable for plan definition, is not in the scope of this paper.

A plan participates to the mapping and the augmentation of the timeline when the order of the incidents on the timeline respects the order of the mapped actions in the plan. In our example, the incident “I_03: Man asking_help” maps onto the action *A : Man askingHelp Driver*, followed by the incident “I_04: Brother stopping Car” mapping onto the action *A : Driver stopping Car*, so the plan P_{b1}^{Man} can participate to mapping (notice that the last part of the plan is not mapped then). Similarly, “I_04: Brother stopping Car” maps onto the action *A : Brother stopping Car*, followed by “I_05_1: Brother leaving with(Car)” mapping onto *A : Brother leaving with(Car)*, so the plan $P_{b2}^{Brother}$ can also participate to mapping.

If the sequence of incidents does not respect the order exhibited by the mapping actions in some plan, that plan is not activated for contribution to mapping.

Once we have identified the incident–action mapping and the plans that contribute to such mapping, we augment the

timeline with the states that hold between adjacent incidents on the timeline. States are taken from the pre–conditions and the effects that are associated with the actions in the plans and are employed to augment the timeline that will be visualized by the tool. So, in the case of the triplet

- *B : Brother believes [SOA : Truck broken]*
- *A : Brother stopping Car*
- *SOA : Car stopped*

with the action mapped onto the incident “I_04: Brother stopping Car”, we have that the state *B : Brother believes [SOA : Truck broken]* will precede the incident, while the state *SOA : Car stopped* will follow the incident.

In order to implement the timeline augmentation, we have devised the following general rule:

Dynamics(?x),
hasStateEffect(?x, ?e),
hasStatePrecondition(?x, ?p),
refersToTimeline(?x, ?t)
 $- >$
hasDynamics(?x, ?p),
hasDynamics(?x, ?e),
refersToTimeline(?p, ?t),
refersToTimeline(?e, ?t)

This rule states that: if x is an instance of the class Dynamics and its position on the timeline is known (y), and x has an effect p and a precondition z, then the preconditions and effects of x will be assigned to the same position y in the timeline. It is the relations “hasStatePrecondition” and “hasStateEffect” that allows the positioning before or after the incident, exactly.

III. CADMOS VISUALIZATION TOOL

In this section we describe the design, both interface and interaction, and the implementation of the visualization tool. The visualization concerns multiple trees of characters’ intentions (or plans), possibly arranged hierarchically on a tree that spans a timeline of events.

The whole visualization space is split into three areas (refer to figure 2): the Agents area (top), where the characters involved (called *agents* in project CADMOS) are listed and can be selected for partial visualizations, the Timeline area, where the augmented timeline is displayed with the incidents (grouped in Units) and the states, grouped in StoryStates, the Plans area, where the plans spanning the timeline incidents are displayed, with actions/states aligned with the mapped incidents/states, or possibly with higher plans aligned with lower plans.

Each narrative incident or state is represented by a box, green color for actions A and events E (lighter green in this case), red color for states. Boxes filled of white in the Plans area (P) means have not been mapped yet to some element in the timeline, but the plan is activated because some of the plan elements (actions or states) have been mapped. Finally, the boxes filled with white color and barred diagonally means have not been realized in the Timeline, thus the plan failed.

All the incidents or states in the timeline have occurred in the plot realization. The timeline incidents pivot the hor-

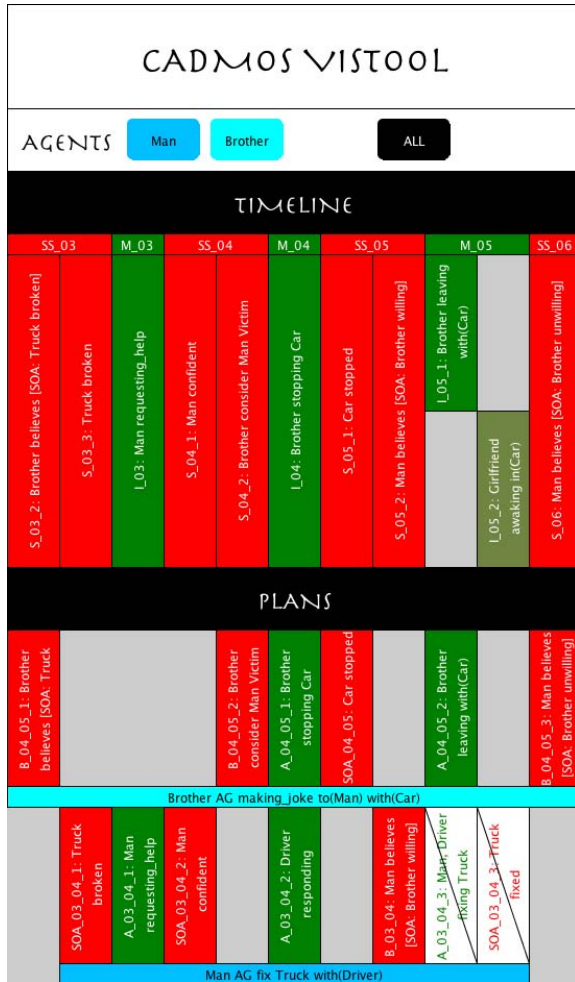


Fig. 2. (c) Augmenting timeline with states projected from plans.

horizontal alignment: each realized plan action is aligned with the matching timeline incident; at the same time states of the plans are propagated to the timeline to represent the story state between adjacent units. The incidents that occur in a unit are considered in parallel, though we decided to assign them an individual position to allow for a visible alignment with the plan action. The plan label is an horizontal box that spans all the states and actions that belong to it.

In figure 2 there is the visualization of the excerpt of “Exit Strategy” described above.

The visualization algorithm proceeds left to right by following the mapping between incidents and plan actions. It assumes the timeline distribution of the states and incidents over the x axis as fixed and aligns the plan actions and consequently the precondition and effect states as a consequence. The plan hierarchy is built downwards, so higher layers will be lower in the visualization. Plans fill lines close to the timeline first and as soon as the alignment does not allow to fit other plans, the algorithm goes lower in the visualization space, proceeding through layers.

IV. EVALUATING THE EFFECTIVENESS OF THE VISUALIZATION TOOL IN TEACHING DRAMA ANALYSIS

The annotation was conducted on the short film *Exit Strategy* produced by Lumiq Studios as part of project CADMOS. We conducted a preliminary annotation of the screenplay as follows. We segmented the storyline into scenes following the author’s description, unless the scenes were already split for mere camera editing reason (e.g., the screenplay indicates that the action has to be seen from several angles and insert a “cut on” in the middle of the action). Then, for each unit we selected one character that seems to show an intentional behavior. For each behavior, we introduced a *plan*. For intentional behavior we intend that the character is not simply reacting to the situation but is the initiator of the action. Therefore we do not describe neither the character’s emotions nor the event that happens by chance. First, we name a plan and its agent; then we list the preconditional states (material or mental) on which it is grounded, the action planned, and the consequent state expected. Each of these is marked as *achieved* or *unachieved* value. By focusing on the deliberation, this annotation stresses the credibility and motivation of character’s behavior.

Once we have a hierarchy of plans, we annotate the video using the same actions, events, states, beliefs, and we render a sequence of timeline elements as perceived from the audience point of view. Incidentally, we discover the elements of the cinematic text that were not rendered by the screenplay annotation. For example, an incident that was not in any plan (because not belonging to any deliberation), could be annotated anywhere in the timeline.

Next, the visualization tool allows us to match the two annotations. Here we see how the timeline corresponds to the constant re-planning of the character as the actions or states they figured in the deliberation fail. Even if the timeline is grounded onto the deliberations of the characters, it needs to count for event and emotion to get its consistency. This led to a specific question about the difference between text and mise-en-scène so ubiquitous in the literature as the difference between drama and performance. There are actions that were implicit in the screenplay so that the annotator had not to annotate them. On the contrary, the actions are stressed in the shooting, rendered in such a way that the timeline annotator had to describe them. For example, this is the case where the man, in need of help for his truck, is deceived by the brother who drives away laughing (see previous sections for plans). Here the shooting and the final editing focus on the deluded man: a state and an action that were given for granted in the script. This leads to a mismatch between the action listed in the plans, and those listed in the timeline, with the mise-en-scène creating a new specific bit of meaning adding to the given script.

The character’s behavior in the script is described diachronically and such are the plans into the annotation. The timeline needs to account for the synchronic delivering of the character’s actions such has to select the bit of meaning that are the most relevant in each scene for the narrative to progress.

For example, there is a fast and intense scene in which the burglars assault the group of friends. Here the complex clash of behaviors is rendered into a stratification of actions, well rendered in the visualization, on which only few are directly matched onto the timeline. This means that the *mise-en-scène* has to select bits of meaning that can be synchronic and account for the diverse intentions.

In teaching drama, it is relevant to describe the dramaturgy of the performance. Our example shows that the plan list can be almost completely mapped onto the timeline, hence showing that the narrative text of dramatic medium is bounded to character's deliberation. In terms of learning about drama structure and meaning, our visualization helps to bridge the gap between the descriptions of the script and of the performance, respectively, and shows the interventions of the latter in terms of dramaturgy. In fact, performance not only adds to the temporal and spatial quality to drama, but also re-shapes the dramaturgy of the script. Therefore, it is relevant to describe the dramaturgy of the performance.

Nowadays drama courses tend to switch from literary to actional qualities. This means that the text is increasingly intended as an incident design (either on stage or on screen). The visualization system allows the teachers to clearly stress the structural elements in the text that are linked to the performance, i.e., it shows the continuity between event design and event performance. The example we have used shows that the plan list can be almost completely mapped onto the timeline, hence can help the class to understand that the narrative text of dramatic medium is bounded to the character's deliberation. This can be used to teach the students how to read the *characters behaviors*. Furthermore, the stratification of agent's plan, as seen in the assault scene, and its mapping onto the timeline, helps the teacher to visualize the *orchestration of conflicts* and their synchronic execution. The visualization of the failed plans, causing a re-deliberation, is a clear indication of the *characters' change* as a key figure into the emotional engagement of the audience. In general, in learning about drama structure and meaning, our visualization helps to bridge the gap among the description of script and of performance, and shows the interventions of the latter in terms of dramaturgy. Nevertheless, our visualization could be more effective if the timeline were expressed also in terms of frames and timecode to give teachers and students a more direct access to the audiovisual document.

V. CONCLUSION

This paper has presented a tool for the visualization of the characters' intentions in a narrative plot. Character's intentions form multiple trees that span a timeline of incidents and the tool is an interactive system for the tree visualization and the selection of the characters one by one. The system is able to build the mapping between a library of plans and the timeline of incidents, and to visualize the contributions of the several characters' intentions to the whole plot.

The system relies on an ontology of drama and builds upon the unrestricted annotation provided by narrative enthusiasts

and media students. The system was tested on the analysis and exposition of the case of a short movie for testing the applicability of the annotation to media production. We hope that such a tool can be useful for media scholars and analysts, and it is susceptible of applicative scenarios within the media industry. Though oriented and tested to the didactics of drama structure our system can be applied to the analysis of news stories, blog entries, or the fruition of cultural heritage through web and mobile applications (see, e.g., [14]).

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