Fortschritt-Berichte VDI

VDI

Reihe 10

Informatik/
Kommunikation

Nr. 848

Herwig Unger, Wolfgang A. Halang (Eds.)

Autonomous Systems 2016

Proceedings of the 9th GI Conference

FernUniversität in Hagen

Schriften zur Informations- und Kommunikationstechnik

Fortschritt-Berichte VDI

Reihe 10

Informatik/
Kommunikation

Herwig Unger, Wolfgang A. Halang (Eds.)

Nr. 848

Autonomous Systems 2016

Proceedings of the 9th GI Conference

FernUniversität in Hagen
Schriften zur Informations- und Kommunikationstechnik

Unger, Herwig; Halang, Wolfgang A. (Eds.)
Autonomous Systems 2016
Proceedings of the 9th GI Conference
Fortschr.-Ber. VDI Reihe 10 Nr. 848. Düsseldorf: VDI Verlag 2016.
236 Seiten, 53 Bilder, 33 Tabellen.
ISBN 978-3-18-384810-2, ISSN 0178-9627,
€ 81,00/VDI-Mitgliederpreis € 72,90.

Keywords: Autonomous Systems – Safety-related and Real-time Systems – Networks and Routing – Suppression of Disturbances – Neural and Evolutionary Computing – Natural Language Processing – Education

To meet the expectations raised by the terms Industrie 4.0, Industrial Internet and Internet of Things, real innovations are necessary, which can be brought about by information processing systems working autonomously. Owing to their growing complexity and their embedding in complex environments, their design becomes increasingly critical. Thus, the topics addressed in this book span from verification and validation of safety-related control software and suitable hardware designed for verifiability to be deployed in embedded systems over approaches to suppress electromagnetic interferences to strategies for network routing based on centrality measures and continuous re-authentication in peer-to-peer networks. Methods of neural and evolutionary computing are employed to aid diagnosing retinopathy of prematurity, to invert matrices and to solve non-deterministic polynomial-time hard problems. In natural language processing, interface problems between humans and machines are solved with graph-based text representation and word segmentation. Finally, related aspects of teaching are discussed.

Bibliographische Information der Deutschen Bibliothek
Die Deutsche Bibliothek verzeichnet diese Publikation in der Deutschen Nationalbibliographie; detaillierte bibliographische Daten sind im Internet unter http://dnb.ddb.de abrufbar.

Bibliographic information published by the Deutsche Bibliothek
(German National Library)
The Deutsche Bibliothek lists this publication in the Deutsche Nationalbibliographie (German National Bibliography); detailed bibliographic data is available via Internet at http://dnb.ddb.de.

Schriften zur Informations- und Kommunikationstechnik
Herausgeber:
Wolfgang A. Halang, Lehrstuhl für Informationstechnik
Herwig Unger, Lehrstuhl für Kommunikationsnetze
FernUniversität in Hagen

ISSN 0178-9627
ISBN 978-3-18-384810-2

Preface

Currently, the terms Industrie 4.0, Industrial Internet and Internet of Things, the latter one coined by Ashton in 1999 with regard to radio-frequency identification, are frequently heard buzzwords. According to the "New Gartner Hype Cycle for Emergent Technologies"[1] published in 2015, the topic Internet of Things has presently reached its "Peak of Inflated Expectations", which is usually followed by the "Trough of Disillusionment". Such a set-back is often caused by incorporating conventional items into new fashions[2], that becomes visible when euphoria gives way to sober thinking. For a trend to prevail, it must then lead into the "Slope of Enlightenment". To this end, real innovations are necessary, which can, with respect to the Internet of Things, to a large extent be brought about by information processing systems working autonomously on devices and network nodes of any kind as considered in this volume.

To begin with, in its first section on safety-related and real-time systems, well-established techniques for modeling safety requirements are reviewed and compared against essential requirements as provided by the standards prevailing for developing safety-related systems, a set of requirements for computer architectures to be inherently safe is derived from these standards, and verification and validation of robotic control software are discussed. For use in embedded safety-critical systems, a control unit is presented, whose main design criterion was verifiability by widest possible consensus, finally, a concept for an affordable, lossless storage of large amounts of measurement data generated on distributed mobile sensor nodes is worked out.

The section on networks and routing first deals with the use of centrality measures. Applying them and status data of sensor nodes, such as battery charging levels, a novel multi-criteria routing strategy for wireless sensor networks is proposed. In combination with topological analysis and information local in a network, then a routing algorithm aiming to maximise traffic flow and feasibility of selected routes is based on a new centrality measure. To ensure continuous re-authentication of peers in peer-to-peer networks, which were in contact before, finally a mechanism inspired by the dinner cryptographic protocol and the zero knowledge protocol is presented.

[1] `http://www.gartner.com/newsroom/id/3114217`

[2] P. Mertens and D. Barbian: Digitalisierung und Industrie 4.0 – Trend mit modischer Überhöhung? *Informatik Spektrum* 39, 4, 301–309, 2016

The following section is devoted to two approaches of suppressing disturbances. To this end, the feasibility of applying chaotic carrier frequency modulation for fighting electromagnetic interferences in switching-mode power supplies by spreading the spectra of input and output signals over the entire frequency band is shown, and the structure of a dual-mode passive filter is investigated by bifurcation analysis, which operates in dependence on a control parameter either as a band-pass or a high-pass.

The first contribution in the section on neural and evolutionary computing details a method combining processing retinal images and machine learning with artificial neural networks in order to aid diagnosing retinopathy of prematurity, the most common cause of blindness of premature infants. Employing an echo state network as universal processing element, the concept of a novel matrix inversion system based on black-box-trained reservoir neurocomputing is then presented. Finally, according to the concepts of evolutionary computation and swarm intelligence, an improved quick artificial bee colony algorithm is proposed to solve a non-deterministic polynomial-time hard problem.

In the section on natural language processing a new graph-based method determining centroid terms as text representatives is presented, which allows to calculate semantic similarities between text documents — even if they have no terms in common, and the difficult task of word segmentation in the Thai language is shown to be improved by an algorithm employing automatically reorganising ranking tries and word usage frequency.

The section on teaching presents the unconventional view that interactive-style teaching as usually employed at universities of applied sciences is equivalent — if not even superior — to many modern approaches of teaching, and introduces an autonomous system for online exercises, which allows students to enter their solutions at any time, and which provides automatically generated feedback with a high degree of detail.

With teaching, here a hub facilitating ubiquitous online learning, also deals the first one of the conference presentations, of which only abstracts are provided in this volume. The further ones present a distributed event-triggered control algorithm to achieve consensus in heterogeneous multi-agent systems' outputs, applications of chaos theory for encryption, managing complex networks and suppression of electromagnetical interferences as exemplified for power converters by aperiodic pulse width modulation techniques, a novel approach of combining responses of selected Gabor filters shifted by certain off-set vectors, which

are automatically trainable for purposes of pattern recognition, and a method to estimate the values of graph parameters.

We are deeply indebted to Jutta Düring for her effort and care in achieving a consistent and appealing layout for this book, to Barbara Kleine for the administrative preparation of the conference, and to FernUniversität in Hagen for supporting the publication of this volume.

Herwig Unger
Wolfgang A. Halang

Contents

Suppression of Disturbances

Neural and Evolutionary Computing

Natural Language Processing

Education

Short Contributions