

ODED MALER

A Memory Box Full of Diamonds

Dejan Ničković

AIT Austrian Institute of Technology



ID CARD

- PhD father, collaborator, friend
- Born in 1957 in Haifa
- Computer scientist with an excursion in management
- Head of hybrid and timed systems group in Verimag
- Original and uncompromising scientist
- Rebel and poet
- Humor, taste of provocation, anecdotes



ALL THE PIECES MATTER

- Science as a piece of a bigger puzzle
- Devoted to family
 - Inseparable wife Dorit
 - Son Ouri and daughter Michal
- Philosophy, history, literature, music, movies, series, ...



CAPTIVE POET

- Book of poems „At least now“ – 1978
- Writing has an extreme importance to Oded
 - Email contents, catchy subject lines
 - Papers, unfinished drafts
- Latexotherapy
 - French café, ..
- Distinctive style
 - Sharp
 - Provocative
 - Poetic, ...

מְכוֹנֵת פְּתִיבָה
 הַמַּיִם לֹא רָתְחוּ
 וְהָאֵבָקָה לֹא הִתְעַרְבָה
 הַקֶּפֶס הָיָה פּוֹשֵׁר
 אֲבָל הַקֶּצֶב הָיָה לֹא רַע
 (בְּהִתְחַשֵּׁב בְּנִסְיוֹן הַדָּל
 וּבְעֵקֶרֶי הַפִּילוֹסוֹפִיָה הַיְהוּדִית
 הַמְפְרִיקָה אֶל הַשְּׂחָקִים).

New Frontiers in Monitoring

Oded Matar

June 10, 2015

Abstract

Latexotherapy triggered by few things including practical aspirations, work on the MISTRAL project, evaluation of confused research proposals and 3/4-life crisis. Bottom line is perhaps that Santa Claus does not exist, contrary to what we have been told or told ourselves.

1 Introduction


I start by some linguistic issues because whenever you use a word to define something, it is important to state what *other* things you want to distinguish it from and these “other” things may change across scientific communities and species.¹ In our by-now-classic work on monitoring MTL and STL properties we distinguish monitoring from verification by the fact that we do not exploit the model except for generating behaviors that we check individually. The model can be something very complex and ugly, often not mathematicizable, written in some simulation/programming language. We paid some lip service to the monitoring of real physical systems (not models) such as injecting tests into chips, monitoring nuclear reactors or enslaving workers in Amazon and even CNRS (you have not published in 3 months!), but this was mostly rhetorical and was technically “reduced” to the fact that we have to do *online* monitoring if we want to be useful pre mortem.


One of the origins of the monitoring movement is the *runtime verification* and the meaning (the contrast with other things) of this term is in at least two orthog-

¹When I was young I went to preach verification of *reactive* systems to AI-robotics. For me the adjective *reactive* meant to characterize programs that maintain an ongoing interaction with an environment, rather than transformational programs that run to completion on static input, but for them, due to existing connections at that time between AI and psychology, “reactive” meant more stimulus-response-like systems compared to systems with cognitive capabilities such as reasoning and planning.

INTERMEZZO 1


NO SUBJECT IS TABOO


 Tue 1/2/2007 7:49 PM
Oded Maler <Oded.Maler@imag.fr>
Are the nightlife of Beograd so intense? ;-)
To Amir Pnueli; Dejan Nickovic


 Tue 1/16/2007 8:03 PM
Oded Maler <Oded.Maler@imag.fr>
Arbaiter macht frei
To Amir Pnueli; Dejan Nickovic


(no technical content - I'm reading your spec and could not help the pun)

--Oded


 Sat 4/21/2007 2:31 PM
Oded Maler <Oded.Maler@imag.fr>
a sad day for the Until - a happy day for humankind?
To Dejan Nickovic; Amir Pnueli

 Sun 4/12/2009 8:47 PM
Oded Maler <Oded.Maler@imag.fr>
better one epsilon in the hand than two epsilons on the three
To Dejan Nickovic; Nir Piterman

 Wed 6/3/2015 7:44 PM
Oded.Maler <Oded.Maler@imag.fr>
non-standard analysis is needed to quantify progress
To Thomas Ferrère; Dođan Ullus; Eugene Asarin; Dejan Nickovic

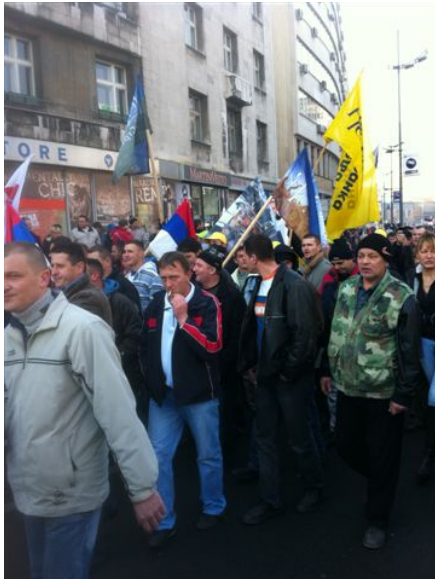
 Mon 6/22/2015 5:28 PM
Oded.Maler <Oded.Maler@imag.fr>
my 2 schillings
To Dejan Nickovic

 Thu 4/16/2015 12:08 PM
Oded Maler <Oded.Maler@imag.fr>
Re: I hope you finish the new version of diagnostics before the Formats deadline is extended ;-)
To Dejan Nickovic
Cc Thomas Ferrère; Dejan Nickovic

 Sun 7/15/2018 3:50 PM
Oded Maler <Oded.Maler@univ-grenoble-alpes.fr>
The Emperor's New Logic - on this one I give you the right for the first night preview
To Dejan Nickovic

CURIOSITY-DRIVEN RESEARCH LIFE

- Fourth Workshop on Formal and Automated Theorem Proving and Applications, February 4-5, 2011, Belgrade, Serbia



```
> I have dozens I just have no time to edit. Yesterday we took a public
> (but two-storey) bus to Zemun. We had no money but the driver told us
> there are no controllers today. So we took the regular rout of the bus,
> seeing not only the facade touristique that you showed us but also the
> backyard (at least we saw were you hide the gypsies) which was quite
> interesting. In the way back we stopped at that shopping mall - few
> generation ahead of grand place and US malls - I mean very wll designed
> from scratch. Not many of the protesters in the march seem to hang
> around there ;-)
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>
> All in all it was a great experience.
>
> --Oded
```

SCIENTIFIC CONTRIBUTIONS

Hybrid systems

- One of the founders of the field
 - „From Timed to Hybrid Systems“ in 1992
- Co-founder HSCC
- Hybrid systems verification tools
 - Pioneering
 - d/dt by Thao Dang
 - State-of-the-art
 - SpaceEx by Goran Frehse

From Timed to Hybrid Systems *

Oded Maler

INRIA/IRISA[†]

Zohar Manna

Stanford University[‡] and Weizmann Institute of Science[§]

Amir Pnueli

Weizmann Institute of Science[§]

Abstract. We propose a framework for the formal specification and verification of *timed* and *hybrid* systems. For timed systems we propose a specification language that refers to time only through *age* functions which measure the length of the most recent time interval in which a given formula has been continuously true.

We then consider hybrid systems, which are systems consisting of a non-trivial mixture of discrete and continuous components, such as a digital controller that controls a continuous environment. The proposed framework extends the temporal logic approach which has proven useful for the formal analysis of discrete systems such as reactive programs. The new framework consists of a semantic model for hybrid time, the notion of *phase transition systems*, which extends the formalism of discrete transition systems, an extended version of Statecharts for the specification of hybrid behaviors, and an extended version of temporal logic that enables reasoning about continuous change.

SCIENTIFIC CONTRIBUTIONS

Timed systems

- Controller synthesis with timed automata
- Scheduling with timed automata
- Real-time specification formalisms
- SMT with difference constraints
- Data structures
- Co-founder of FORMATS

Automata theory and learning

- Cascade decomposition
- Pushdown automata
- Probabilistic automata

Systems biology

- Application of timed and hybrid systems to biology

Runtime monitoring

INTERMEZZO 3

SINGLE AUTHOR

Date: Tue, 11 Aug 2009 15:39:34 +0200
From: Oded Maler <Oded.Maler@imag.fr>
To: Dejan Nickovic <dejan.nickovic@epfl.ch>
Subject: Re: Hi from Aalborg

Did you see Morari finally? Why don't you finish the JACM version, by the way..

--Oded

- Autumn 2009 – Amir Pnueli passes away...

Date: Mon, 30 Nov 2009 16:37:09 +0100
From: Oded Maler <Oded.Maler@imag.fr>
To: Dejan Nickovic <Dejan.Nickovic@imag.fr>
Subject: JACM paper

I hope you don't want to wait until you become a single author..

--Oded

- May 2018 – JACM submission

From Real-Time Logic to Timed Automata*

THOMAS FERRÈRE, IST Austria
ODED MALER, CNRS / Verimag
DEJAN NIČKOVIĆ, Austrian Institute of Technology AIT
AMIR PNUELI†, Weizmann Institute of Science and New York University

We show how to transform formulae written in the real-time temporal logic MITL into timed automata recognizing their satisfying models, taken to be continuous-time Boolean signals. This compositional construction is much simpler than previously known; it supports both past and future operators and can easily be extended.

- November 2018 – JACM acceptance

- 2006

From MITL to Timed Automata*

Oded Maler¹, Dejan Nickovic¹ and Amir Pnueli^{2,3}

¹ Verimag, 2 Av. de Vignate, 38610 Gières, France
[Dejan.Nickovic | Oded.Maler]@imag.fr

² Weizmann Institute of Science, Rehovot 76100, Israel

³ New York University, 251 Mercer St. New York, NY 10012, USA

Amir.Pnueli@cs.nyu.edu

Abstract. We show how to transform formulae written in the real-time temporal logic MITL into timed automata that recognize their satisfying models. This compositional construction is much simpler than previously known and can be easily implemented.

Prediction is very difficult, especially about the future.

Niels Bohr

- 2008 – we lift restrictions from 2006

Date: Tue, 18 Mar 2008 15:46:14 +0100
From: Oded Maler <Oded.Maler@imag.fr>
To: Amir Pnueli <amir@cs.nyu.edu>
CC: Dejan Nickovic <Dejan.Nickovic@imag.fr>
Subject: Science update

Amir, Just to let you know that we have started writing a journal version of MITL to automata, for an MITL which has event and, alas, requires all the panoply of closed-open combinations, which does not make life cleaner. Hopefully we end up less ugly than Alur & Henzinger's paper.

--Oded

INTERMEZZO 4

ON EGO, SELF-QUESTIONING, SELF- IRONY...



Oded Maler
Research Director
CNRS-VERIMAG

[Contact information](#)

Research interests: Theory of Automata, Timed and Hybrid Systems, Verification, Synthesis and Monitoring of Systems, Scheduling and Planning

Short Curriculum Vitae

"In the beginning [God](#) created the heavens and the earth. And the earth was without form, and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters."

[...]

Oded Maler was born in 1951 in Haifa, Israel. He obtained his B.A. in Computer Science from the Technion, Haifa in 1979 and his M.Sc. in Management Science from the University of Tel-Aviv in 1984. In 1989 he finished his Ph.D. thesis ("Finite Automata: Infinite Behavior, Learnability and Decomposition"), under the liberal supervision of A. Pnueli in the department of Applied Mathematics and Computer Science, Weizmann Institute, Rehovot. After two years of post-doc at IRISA, Rennes, he moved to Grenoble in 1992 and obtained a research position (CRU) at the CNRS (French National Center of Scientific Research) in 1994. He has been promoted to "research director" (DR2) in 2001. And he lives more or less happily ever after.

Dr. Maler is the founder and honorary president of the association [Charlottes Sans Frontières](#).

Warm topics

- [Publications](#)
- [Workshops: Logic in Computation and Control](#), Santa Barbara 27-28/7/2006 a satellite event of [HSCC 2006](#)
- [Timed and Hybrid Systems research at Verimag 2000-2005 Slides \(in French\)](#)
- [O. Maler: Fixating the Clock Explosion \(slides\)](#)

G. Frehse, O. Maler, [Modeling and Analysis of Switched Buffer Networks using Hybrid Automata](#), semi-rejected, 2006
 R. Ben Salah, M. Bozga, O. Maler, [On Interleaving in Timed Automata](#) CONCUR, 2006 [Slides](#)
 S. Cotton, O. Maler, [Fast and Flexible Difference Logic Propagation for DPL\(L\)](#), SAT, 2006, [Slides](#)
 S. Cotton, O. Maler, [Satisfiability Modulo Theory Chains with DPL\(L\)](#), rejected, 2006
 O. Maler, D. Nickovic, A. Pnueli, [From MITL to Timed Automata](#), FORMLATS, 2006, [Slides](#)
 R. Ben Salah, M. Bozga, O. Maler, [Automatic Abstraction of Timed Components](#), rerejected, 2006

- S. Cotton, O. Maler, [Fast and Flexible Difference Logic Propagation for DPL\(L\)](#), SAT, 2006, [Slides](#)
- S. Cotton, O. Maler, [Satisfiability Modulo Theory Chains with DPL\(L\)](#), rejected, 2006
- O. Maler, D. Nickovic, A. Pnueli, [From MITL to Timed Automata](#), FORMLATS 2006, [Slides](#)
- R. Ben Salah, M. Bozga, O. Maler, [Automatic Abstraction of Timed Components](#), rerejected, 2006
- E. Asarin, T. Dang, G. Fohs, A. Girard, C. Le Gouesic, O. Maler, [Recent Progress in Conformance and Hybrid Reachability Analysis](#), CACSAD 2006



Tue 7/17/2018 6:25 PM

Oded Maler <Oded.Maler@univ-grenoble-alpes.fr>

The Emperor's New Logic

To: Ničković Dejan; Dogan Ulus; Thomas FERRERE; Alexey Bakhtirkin; Nicolas Basset; Eugene Asarin; Alexandre Donzé
 Cc: Thao Dang; Jyo Deshmukh (TEMA TTC); Goran Frehse; Bruce Krogh

I We removed extra line breaks from this message.

The Emperor's New Logic

This note is motivated by the discussion with Dejan et al about defining a richer (I won't say universal) signal description language. To waste precious time, I will discuss limitations of STL as a way to specify and describe signals. Those limitations also underly some of its strength as satisfying some expressivity thirst, real or imagined, in the signal and trajectory worlds, more specifically in the niche of very permissive under-determined specifications.

Anecdotes and name droppings.

When I candidated at INRIA Rennes and talked among other things on verification of HS, someone asked me what I do mean by those "properties" of HS to be verified. My evaluator Joseph was not sure either at the beginning. I did not get that position and I don't blame them at all.

In one of the early HS workshops in Nerode's Ithaca, I presented our work on timed digital circuits, with non deterministic delay operators on Boolean signals, and the infamous R. Brocket asked me what do I mean by "signals". And indeed, signals and systems are at the core of this cloud of domains that overlap control, signal processing, EE, communication etc. to which we partially infiltrated in the HS adventure.

In my unpublished (unwritten) "Please do not disturb" paper, I observed that in the continuous reachability game for some $x' = f(x, v)$, the disturbance v is only restricted to be in some V for all t , which leaves room to weird signals of arbitrary frequency, and that doing verification wrt those is an overkill. Another instance of a very weak constraint on signals.

SIGNAL TEMPORAL LOGIC

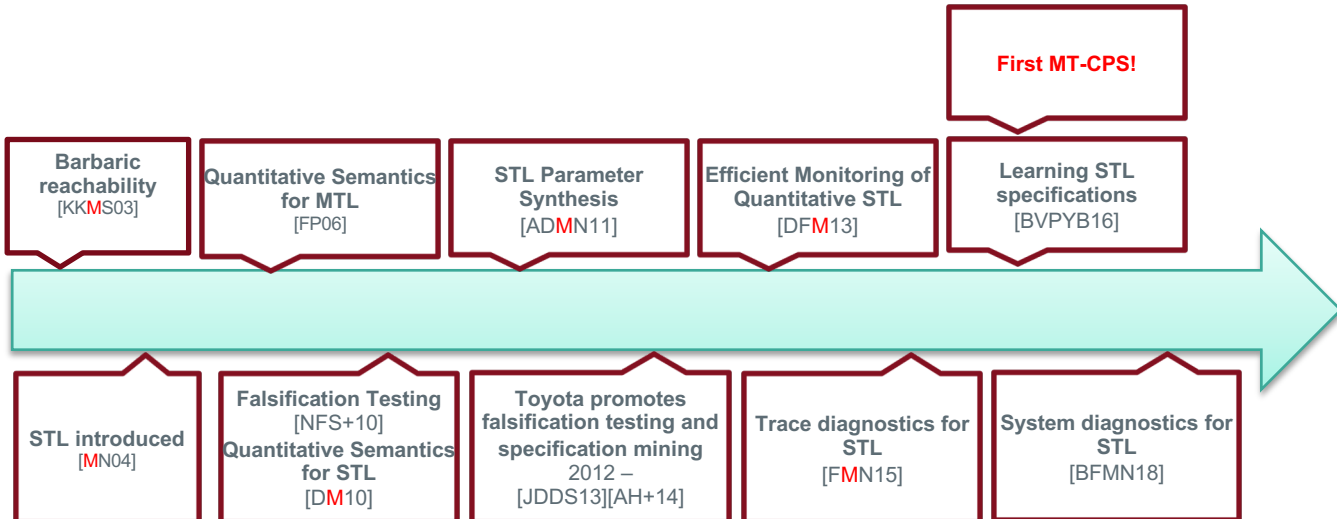
and the Rise of the Barbaric¹ Empire

¹ The term barbarian comes from the Greek varvar which means people who do not speak our language - J. Sifakis, personal communication, around 15 BW (before Wikipedia).

BEGINNINGS

- 1990s: dawn of hybrid systems
- 2000: vivid field with substantial progress in theory and tools
- Scalability remains a big issue
 - Not to be solved anytime soon
- Oded thinks about **barbaric** verification
 - Simulation-based verification
 - Monitoring specifications
- Inspired by trends in digital HW
 - Discussions with Dolphin Integration
 - Assertion-based verification
 - Property Specification Language (PSL)
 - Sugar (IBM) + ForSpec (Intel)
 - Becomes IEEE Standard in 2005
- EU FP6 project Prosyd
 - Property-based design
 - Analog extensions of PSL
 - Umbrella for my PhD thesis

EVOLUTION OF STL



EVOLUTION OF STL - PUBLICATIONS

[KKMS03] James Kapinski, Bruce H. Krogh, Oded Maler, Olaf Stursberg: On Systematic Simulation of Open Continuous Systems. HSCC 2003: 283-297

[MN04] Oded Maler, Dejan Nickovic: Monitoring Temporal Properties of Continuous Signals. FORMATS/FTRTFT 2004: 152-166

[DM10] Alexandre Donzé, Oded Maler: Robust Satisfaction of Temporal Logic over Real-Valued Signals. FORMATS 2010: 92-106

[ADMN11] Eugene Asarin, Alexandre Donzé, Oded Maler, Dejan Nickovic: Parametric Identification of Temporal Properties. RV 2011: 147-160

[DFM13] Alexandre Donzé, Thomas Ferrère, Oded Maler: Efficient Robust Monitoring for STL. CAV 2013: 264-279

[JDDS13] Xiaoqing Jin, Alexandre Donzé, Jyotirmoy V. Deshmukh, Sanjit A. Seshia: Mining requirements from closed-loop control models. HSCC 2013: 43-52

[AH+14] Houssam Abbas, Bardh Hoxha, Georgios E. Fainekos, Jyotirmoy V. Deshmukh, James Kapinski, Koichi Ueda: Conformance Testing as Falsification for Cyber-Physical Systems. CoRR abs/1401.5200 (2014)

[FMN15] Thomas Ferrère, Oded Maler, Dejan Nickovic: Trace Diagnostics Using Temporal Implicants. ATVA 2015: 241-258

[BVPYB16] Giuseppe Bombara, Cristian Ioan Vasile, Francisco Penedo, Hirotohi Yasuoka, Calin Belta: A Decision Tree Approach to Data Classification using Signal Temporal Logic. HSCC 2016: 1-10

[BFMN18] Ezio Bartocci, Thomas Ferrère, Niveditha Manjunath, Dejan Nickovic: Localizing Faults in Simulink/Stateflow Models with STL. HSCC 2018: 197-206

IMPACT OF STL

Applications

- Offline monitoring
- Runtime monitoring
- Search-based testing
- Parameter synthesis
- Specification mining
- Model predictive control

Application domains

- Automotive
- Semiconductor
- Systems biology
- Medical
- Education
- Robotics
- Music

Extensions

- Quantitative semantics
- STL*
- FO-STL
- HyperSTL
- Avg-STL
- STL + RE
- STL + spatial



SOME MORE MEMORIES FROM MY BOX



ODED MALER

BARBARIC SCIENCE FROM A CAPTIVE POET

Central memorial event
Thursday, April 18, 16h

Oded Maler - Barbaric Science from a Captive Poet

Thursday, April 18, 2019, 4:00pm-7:00pm

Speakers:

- Rajeev Alur
- Eugène Asarin
- Albert Benveniste
- Jyotirmoy Deshmukh
- Bruce Krogh
- Manfred Morari



This event celebrates the life and scientific legacy of Oded Maler (1957-2018). Oded sadly left us in September 2018, leaving a huge void in our research community. He was a computer scientist, a CNRS research director at Verimag lab, a steering committee member of HSCC, and one of the founders of HSCC. A truly original and unconventional scientist, he was not only a pioneer in hybrid systems research, but also deeply interested in a wide range of topics including automata theory and learning, timed systems and logics, runtime monitoring and system biology.

Oded often said that he felt like a poet trapped in the body of a computer scientist. And he was indeed a poet, publishing the book of poems in Hebrew "At least now" in 1978. In his scientific career, writing played an extremely important role and Oded nurtured a sharp, provocative and poetic style in his research papers.

More recently, Oded liked to say that he was doing barbaric research, where the word "barbaric" had a two-fold meaning. It denoted his penchant to do research against the mainstream and across disciplines. It also marked Oded's transition from more theoretical hybrid system research to the more applied simulation-based methods.

THANK YOU!

Special thanks go to:

Dorit Maler for sharing their family pictures

Olivier Lebeltel for retrieving my email correspondence with Oded from 2005 to 2018

Jyotirmoy Deshmukh and **Jim Kapinski** for helping with the timeline