

# Qualitative Temporal Representation and Reasoning about Points, Intervals and Durations

Silvana Radaloni  
University of Padova

Dept. of Electronics and Computer Science  
Via Gradenigo 6A - 35100 Padova - Italy  
radaloni@iadebepd.cnr.it

Massimiliano Giacomini  
University of Brescia

Dept. of Electronics and Automation  
Via Branze 38 - 25123 Brescia - Italy  
giacomini@ing.unibs.it

Claudio Masolo  
University of Padova

Dept. of Electronics and Computer Science  
Via Gradenigo 6A - 35100 Padova - Italy  
masolo@iadebepd.cnr.it

## Abstract

*Recently, an elegant framework called  $\mathcal{N}^2\mathcal{TL} [R]$  has been proposed for representing qualitative information about time intervals and durations.  $\mathcal{N}^2\mathcal{TL}$  is a single network, therefore it avoids typical problems of bi-networks, and in addition it has interesting computational properties. In this paper, we extend  $\mathcal{N}^2\mathcal{TL}$  in two directions: we enrich its expressive power by introducing points and introducing the same computational properties, and we provide it with an automatic theory able to handle qualitative temporal information about points, intervals and durations in a unified framework. This theory is based on general interval axioms and two relations: general meets and not longer than.*

## 1. Introduction

In many domains, it is more important to consider the relative information concerning the durations of two temporal intervals instead of considering the absolute knowledge about a single interval. If durations are taken as distances between endpoints of intervals then qualitative constraints as "the duration of the interval  $I$  is shorter than the duration of the interval  $J$ " cannot be represented in a binary constraint network since they concern four points. This problem is usually overcome encoding duration information in a network orthogonal to the interval relationship network, but this strategy presents some limits. In the IA framework [1] it does not guarantee the total consistency

of the network [7]. In the same line, there are other bi-network based works proposed for representing information about durations: PDM [2] and APDM [12]. PDM is a point-duration network defined as a structure formed by two point algebra networks, separately but not independently, as binary constraints are introduced for relating point and duration information. APDM extends PDM where only qualitative information is considered, by representing both qualitative and quantitative information about point events. Like other point-based approaches, they do not handle the disjointness of interval algebras.

The PDM framework [9] considers a single network able to handle both qualitative and quantitative temporal information about points, intervals and durations, but its high expressive power is achieved at the price of its computational properties.

Recently, an elegant subframework of PDM called  $\mathcal{N}^2\mathcal{TL} [3]$  has been proposed.  $\mathcal{N}^2\mathcal{TL}$  represents only qualitative information about time intervals and durations and it has interesting computational properties. The set of interval relations considered is an extension of 13 Allen's relations [1] integrated with qualitative information about durations  $\{<, =, >\}$ . For example, the relation  $k$  is extended to the three relations  $\{k^<, k^=, k^>\}$ , while other relations such as  $\{rc, s, ec, d, ds, f, fi\}$  which include implicit information about interval durations, are left unchanged. Thus, 26 basic relations between pairs of intervals are considered. The  $\mathcal{N}^2\mathcal{TL}$  network exhibits similar characteristics as the IA-network concerning tractable subclasses (Consistent as well as Pre-consistent). But the level of local consistency to achieve global consistency is  $\theta$ -consistency [4]

# Temporal Representation And Reasoning Time 00 Proceedings

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