# Spatiotemporal Cooperation at the Geographic Scale

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Spatiotemporal observations are fundamental in the context of analysing behaviours monitored in empirical sciences. A specific subfield is spatiotemporal cooperation that models spatiotemporal relations among agents in order to describe how they collaborate in space and over time: one example is the field of traffic supervision where a number of moving objects is observed; this has, for instance, relevance for autonomous transport and intralogistics. A prominent example are autonomous vehicles that collaboratively unload container vessels at container terminals or that handle material flows in shop floors.

There are two basic scenarios: one might either take up the role of an observer who analyses a group of agents, or one might be herself member of such a group[1]. In both cases an adequate representation is required that models the spatiotemporal behaviours among agents.

This poster shows a number of jointly exhaustive and pairwise disjoint spatiotemporal motion relations[2]. These relations are easily comprehensible for both an observer of a scene of agents moving around and an agent being herself part of such a scene: only the two sides of a reference object as well as the front, middle, and back of this reference object are distinguished (Fig. 1). These simple distinctions make those relations easily perceivable for cognitive agents.

Here, we apply these relations without committing ourselves to any environmental confines. It shows that these relations aid in making incomplete knowledge complete, dealing with coarse and imprecise knowledge, and describing spatiotemporal cooperation without the employment of artificial, external scales: a group of agents itself defines the reference for the spatiotemporal behaviour descriptions of its members.
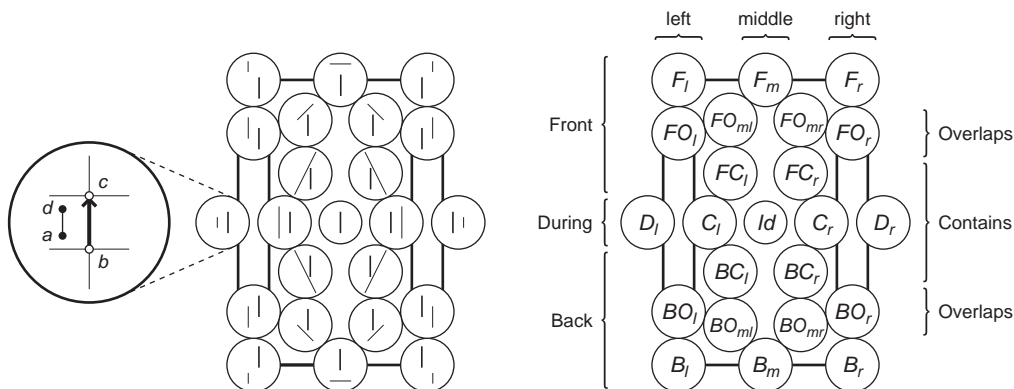


Fig. 1: Left: Example configurations for the 23 $BA_{23}$ relations. The highlighted configuration explains how line segment $ad$ is related to line segment $bc$. Right: Mnemonic labels for all $BA_{23}$ relations

1 Schuldt, A. and Werner, S., *Towards Autonomous Logistics: Conceptual, Spatial, and Temporal Criteria for Container Cooperation*, H.-D. Haasis et al., Proceedings of the International Conference on Dynamics in Logistics: Bremen, Germany, August 28-30 2007, pp. 311-319, Springer-Verlag, 2008.

2 Gottfried, B., *Reasoning about Intervals in Two Dimensions*, W. Thissen et al., Proceedings of the IEEE International Conference on Systems, Man & Cybernetics: The Hague, The Netherlands, October 10-13 2004, pp. 5324-5332, IEEE Press, 2004.