**Title:** Coordination Design

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**Abstract:** For multi-robot applications, there are not yet many examples where crossing the reality gap between laboratory demonstration and product usage has been achieved. In several workshops at major robotics conferences the difficulties encountered during the crossing process have been expressed.

One inherent difficulty is the evaluation of the effectiveness of possible coordination schemes which can be implemented in the multi-robot system. This is especially true for applications where the variability of environmental conditions demands a robust adaptation process of the coordination scheme at run-time, which in turn makes a straight-forward evaluation of effectiveness a computationally difficult task, even if associated MC simulations are cleverly designed.

In our poster, we outline a newly developed design methodology which results in systems with an associated (analytically founded) effectiveness with regard to a given operational task. Furthermore, we discuss similarities and differences between this methodology and publications and presentations in a recent Journal Special Issue and workshops dealing with multi-robot systems (IEEE TASE SI, ICRA Crossing the Reality Gap Workshops 2012-2014, IROS 2014 Workshop on the future of multiple-robot research).

The idea behind the newly developed, so-called "trading design methodology" presented in this poster is to start the crossing process with a system description at design-time that has a theoretically provable effectiveness. This system design suffers, however, low efficiency. The next step is to start a process of optimizing the efficiency while maintaining the designed and demanded level of effectiveness. This process is applicable at both time frames, at design-time and during run-time. The optimization process contains access to a database (ontology), avoiding potentially critical parameter settings which are potentially harming the effectiveness of the entire system. If the same ontology is implemented on all platforms of the multi-robot team, coordination is possible with minimal communication between the platforms at run-time.

In the previous workshops and in follow-on journal papers other design methodologies have been followed. Compared with the "trading design methodology" the questions tried to be answered in this poster are whether there is a way to categorize the different design methodologies and if so how this categorization can be used to actually evaluate the effectiveness of coordination methods which result from the application of the different design methodologies. To visualize the various design methodologies we utilize a 2D-plot (effectiveness vs. efficiency) and have a closer look at the optimization processes inherent to the design methodologies.

We conclude with a proposal for the multi-robot research community to think about an ontology based categorization of multi-robot system design, clearly separating methodologically advised optimization steps (solution oriented criticality) from application specific adjustments of multi-robot coordination (application oriented criticality). An application problem is only comprehensively understood if several methodologies lead to consistent insights. Therefore, benchmark competitions should be investigated that allow for simultaneous applications of several methodologies and consequently a fair comparison of coordination schemes derived by these methodologies.