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Appendix A : Derived Publications

This appendix lists all the papers that were published, or are currently being reviewed, that were derived from the work leading to this thesis.

1) D. Rodić and A. P Engelbrecht. Investigation into Applicability of Social Networks as a Task Allocation Tool for Multi-Robot Teams. *Computational Intelligence, Robotics and Autonomous Systems (CIRAS 2003)*, Singapore, Program and Abstracts, pp. 133, 2003.
2) D. Rodić and A. P Engelbrecht. Social Networks as a Coordination Technique for Multi-Robot Systems. *Intelligent Systems Design and Applications*, Springer, pp. 503-513, 2003.
3) D. Rodić and A. P Engelbrecht. Investigation of Low Cost Hybrid Three-Layer Robot Architecture. *Computational Intelligence, Robotics and Autonomous Systems (CIRAS 2003),* Singapore, Program and Abstracts, pp. 85, 2003.
4) D. Rodić and A. P. Engelbrecht. INDABA – Proposal for Intelligent Distributed Agent Based Architecture. *Computational Intelligence*, *Robotics and Autonomous Systems (CIRAS 2003)*, Singapore, Program and Abstracts, pg 85, 2003.
5) D. Rodić and A. P. Engelbrecht. Framework for Interaction in a Multi Agent Systems. *South African Institute of Computer Scientists and Information Technologists conference (SAICSIT 2002),* Port Elizabeth, South Africa, published on CD, 2002.
6) D. Rodić and A. P. Engelbrecht. Framework for Interaction in a Multi Agent Systems. *South African Institute of Computer Scientists and Information Technologists conference (SAICSIT 2003),* Proceedings of the Post Graduate Symposium, pp 30-32. Johannesburg, South Africa. 2003.
7) D. Rodić and A. P. Engelbrecht. Social Networks as a Task Allocation Tool for Multi-Robot Teams. *South African Computer Science Journal 33,* pp53-67*,* 2004.
8) D. Rodić and A. P. Engelbrecht. Interesting Features of Social Networks as Applied to Multi-Robot Teams Task Allocation. *Submitted to IEEE Transactions on Man, Machine and Cybernetics.* 2005

Appendix B : Acronyms

This appendix provides a brief summary of the most commonly used acronyms in this thesis.

ACL	Agent Communication Language.
API	Application Programming Interface.
AI	Artificial Intelligence.
BBR	Behaviour Based Robotics.
BSA	Behavioural Synthesis Architecture.
BDI	Belief-Desire-Intention architecture.
BLE	Broadcast of Local Eligibility.
CBSE	Component Based Software Engineering.
CNP	Contract Net Protocol.
DAI	Distributed Artificial Intelligence.
GPS	General Problem Solver.
INDABA	INtelligent Distributed Agent Based Architecture.
IT	Information Technology.
KQML	Knowledge Query and Manipulation Language.
KSE	Knowledge Sharing Effort.
MDP	Markov Decision Process.
MACTA	Multiple Automata for Complex Task Achievement.
MAS	Multi-Agent System.
NQC	Not Quite C.
OOP	Object Oriented Programming.
STRIPS	Stanford Research Institute Problem Solver.
XML	eXtended Markup Language.

Appendix C : Terms and Definitions

This appendix provides a brief summary of the most commonly used terms and definitions in this thesis.

Agent: A computer system, situated in some environment that is capable of flexible autonomous action in order to meet its design objectives.

Agency: A notion of characteristics that define an agent. In this thesis, the characteristics of agents are a*utonomy, interaction, collaboration and learning.*

Architecture: A general methodology for designing particular modular decomposition for particular tasks.

Auctioning Coordination Approach: An approach to coordination based on organisational sciences in general and in market based approaches in particular. It is widely used as a coordination tool in MASs.

Behaviour: An algorithm that acts as a control law that encapsulates sets of constraints in order to achieve a specific task.

Clique: A subset of agents that is defined by the existence of strong relationships between them.

Conflict: A negative interaction between agents in MAS.

Controller Layer: A layer in hybrid three layer architectures. The controller layer usually encapsulates behaviours that allow for fast, real-time, interaction with the environment. It is sub-symbolic in nature.

Cooperation: A process that promotes the optimal state of a MAS, by enabling positive interaction between agents in a MAS, usually requiring communication between agents.

Cooperative Problem Solving: A process that promotes cooperation between agents. The cooperative problem solving process consists of four sub processes, namely *potential recognition, team formation, plan formation* and *plan execution.*

Coordination: A process that promotes positive interaction and restricts negative interaction between agents in MASs. The most common coordination approaches have origins in biological or organisational sciences.

Deliberator Layer: A layer in hybrid three layer architectures. The deliberator layer usually reasons using symbolic reasoning techniques such as inference and backward chaining. The deliberator layer also maintains a symbolic world model.

Hybrid Architecture: An architecture that uses both symbolic and sub-symbolic knowledge representation and exploits the strengths of each approach.

Interaction Layer: A layer introduced in the INDABA framework. The main purpose of the interaction layer is to facilitate coordination between the agents in a MAS, by providing an easy way of encapsulating a coordination mechanism in the agent architecture.

Learning: The ability of a system to learn, based on previous experience from its interaction with the environments, by improving its performance.

Multi-Agent System: A society of agents.

Multi-Robot Team: A society of robots.

Reactive Architecture: An architecture that is used for implementing reactive agents. A reactive architecture is sub-symbolic in its nature. The central premise of reactive architectures is that intelligent behaviour will emerge from agent's interaction with its environment.

Robot: An agent embedded in a real physical body in a physical environment.

Sequencer Layer: A layer in hybrid three layer architectures. The sequencer layer usually serves as an interface between the deliberator layer (that uses a symbolic knowledge representation) and the controller layer (that uses a sub-symbolic knowledge representation).

Symbolic Architecture: Architecture that contains an explicitly represented, symbolic model of the world, and in which decisions are made via logical (or at least pseudo-logical) reasoning, based on pattern matching and symbolic manipulations.

Social Network: A social network is a set of agents and a distinct relationship among the agents.

Social Networks Based Approach: A novel approach to coordination in MASs, based on the use of identified social relationships in a MAS.

Social Relationship: Relationships that link agents to each other. The relationships can either be positively or negatively weighted, and are directed. Examples of social relationships used in this thesis are trust and kinship.

Three Layer Architecture: The predominant hybrid robot architecture. The three layer architectures consist of three layers, namely *controller*, *sequencer* and *deliberator* layers.

Appendix D : Definition of Symbols

This appendix lists the commonly used symbols found throughout this thesis.

$\boldsymbol{T_k}$	A task that needs to be allocated to a multi-robot team, defined by the *n*-tuple $(T_{k1}, T_{k2}, \ldots, T_{kn})$.
$\boldsymbol{T_{ki}}$,	i-th attribute of task T_k .
$\boldsymbol{A_x}$	An agent in a MAS, defined by the *m*-tuple $(A_{x1}, A_{x2}, \ldots, A_{xm})$
$\boldsymbol{A_{xi}}$,	i-th attribute of agent A_x .
$\boldsymbol{A_{lk}}$	An agent selected as a team leader.
$\boldsymbol{R_i(A_{lk}, A_x, T_k)}$	The i-th relationships between the team leader A_{lk} and agent A_x in relation to task T_k.
$\boldsymbol{F_{xk}(A_{lk}, A_x, T_k)}$	Scoring function for agent A_x in relation to team leader A_{lk} and to task T_k.
$\boldsymbol{t(R_1, R_2, T)}$	Trust relationship that quantifies the reliability of robot R_1 in relation to R_2, based on the historical performance related to task T that has involved both robots.
$\boldsymbol{d(R_1, R_2)}$	Kinship relationship that is defined as the similarity between robots R_1 and R_2.