Proceedings, Annual Conference - Canadian Society for Civil Engineering
Volume 3, 2009, Pages 1256-1265

ISBN: 978-161567376-6
CODEN: PCSEE
Document Type: Conference Paper
Source Type: Conference Proceeding

Canadian Society for Civil Engineering Annual Conference 2009; St. Johns, NL; 27 May 2009 through 30 May 2009; Code 78615

Collaborative multi-agent system for supporting construction equipment

Zhang, C.[a], Hammad, A.[b], AlBahnassi, H.[a]

[a] Building, Civil and Environmental Engineering Department, Concordia University, Montreal, QC, Canada
[b] Concordia Institute for Information Systems Engineering, Montreal, QC, Canada

Abstract

This paper proposes collaborative multi-agent system for real-time planning and monitoring of construction sites. A multi-agent system framework is discussed to support construction equipment operators by using agents and field data capturing technologies. Data collected from sensors attached to the equipment, in addition to an up-to-date 3D model of the construction site, are processed by the multi-agent system to detect any possible collisions or other conflicts related to the operations of the equipments, and to generate a new plan in real time. Different algorithms for path planning, path re-planning, and centralized and distributed decision-making are investigated for using in the multi-agent system. The paper summarizes the undergoing research and a preliminary outdoor test for capturing field data.

Language of Original Document

English

References (33) view in table layout

Select: **Page**

1. Deen Ali, M.S.A., Babu, N.R., Varghese, K.
Collision free path planning of cooperative crane manipulators using genetic algorithm
(2005) *Journal of Computing in Civil Engineering*, 19 (2), pp. 182-193. Cited 12 times.
doi: 10.1061/(ASCE)0887-3801(2005)19:2(182)
Abstract + Refs | View at Publisher | S·F·X

2. Arizono, Noriyoshi, Shiota, Kenji, Uemura, Yutaka, Sasada, Takashi, Morikawa, Yasuhiko, Onoda, Masaru
Crane operation support system
(1993) *R and D: Research and Development Kobe Steel Engineering Reports*, 43 (1), pp. 47-50. Cited 3 times.
Abstract + Refs | S·F·X

3. Bilek, J., Hartmann, D.
Development of an Agent-based Workbench Supporting Collaborative Structural Design
(2003) *Proceedings of the 20 th CIB W78 Conference on IT in Construction*. Cited 4 times.
New Zealand
S·F·X

4. Brandt, D.
Comparison of A* and RRT-Connect Motion Planning Techniques for Self-reconfiguration Planning
(2006) *Proceedings of the 2006 IEEE/RSJ International Conference on Intelligent Robots and Systems*. Cited 3 times.
China
S·F·X

5. Choset, H., Lynch, K.M., Hutchinson, S., Kantor, G., Burgard, W., Kavraki, L.E., Thrun, S.
(2005) *Principles of Robot Motion - Theory, Algorithms, and Implementations*. Cited 248 times.
the MIT Press, Cambridge
S·F·X

6. Cranimation
(2006)
http://www.cranimax.com
S·F·X

7. (2008)
Crane Accident Statistics
http://www.craneaccidents.com/stats.htm
S·F·X

8. (2008) *Commission de la santé et de la sécurité du travail*
CSST, du Québec
http://www.csst.qc.ca/portail/fr

9. Davis, B.R. and Sutton S.C. 2003. A Guide to Crane Safety. N.C. Department of Labor, Division of Occupational Safety and Health.

10. Durfee, E.H.
Distributed continual planning for unmanned ground vehicle teams
(1999) *AI Magazine*, 20 (4), pp. 55-61. Cited 8 times.

11. Ferber, J.
(1999) *Multi-Agent System, An Introduction to Distributed Artificial Intelligence*. Cited 804 times.
Addison-Wesley, Pearson Education Limited

12. Ferguson, D.
(2006) *Single Agent and Multi-agent Path Planning in Unknown and Dynamic Environments*. Cited 2 times.
Ph. D. Dissertation, The Robotics Institute, Carnegie Mellon University

13. Ferguson, D., Kalra, N., Stentz, A.
Replanning with RRTs
(2006) *Proceedings - IEEE International Conference on Robotics and Automation*, 2006, art. no. 1641879, pp. 1243-1248. Cited 8 times.
ISBN: 0780395069; 978-078039506-0
doi: 10.1109/ROBOT.2006.1641879

14. Kamat, V.R., Martinez, J.C.
Visualizing simulated construction operations in 3D
(2001) *Journal of Computing in Civil Engineering*, 15 (4), pp. 329-327. Cited 63 times.
doi: 10.1061/(ASCE)0887-3801(2001)15:4(329)

15. Kang, S.
(2005) *Computer Planning and Simulation of Construction Erection Processes using Single or Multiple Cranes*
Ph. D. dissertation, Department of Civil and Environmental Engineering, Stanford University

16. Kang, S., Miranda, E.
Planning and visualization for automated robotic crane erection processes in construction
(2006) *Automation in Construction*, 15 (4), pp. 398-414. Cited 12 times.
doi: 10.1016/j.autcon.2005.06.008

17. Kim, K. and Paulson, Jr.B.C. 2003. Agent-based Compensatory Negotiation Methodology to Facilitate Distributed Coordination of Project Schedule Changes. Journal of Computing in Civil

Engineering, ASCE, 17(1): 10-18.

18. Lee, J., Bernold, L.E.
Ubiquitous agent-based communication in construction
(2008) *Journal of Computing in Civil Engineering*, 22 (1), pp. 31-39. Cited 3 times.
doi: 10.1061/(ASCE)0887-3801(2008)22:1(31)

19. (2007)
LiftPlanner
http://www.liftplanner.net

20. (2008)
NIOSH , The National Institute for Occupational Safety and Health

21. Nwana, H.S., Ndumu, D.T.
(1998) *A Brief Introduction to Software Agent Technology, Agent Technology, Foundations, Applications, and Markets*
Springer

22. Ren, Z., Anumba, C.J.
Learning in multi-agent systems: A case study of construction claims negotiation
(2002) *Advanced Engineering Informatics*, 16 (4), pp. 265-275. Cited 15 times.
doi: 10.1016/S1474-0346(03)00015-6

23. Russell, S., Norvig, P.
(2003) *Artificial Intelligence, A Modern Approach*. Cited 3681 times.
second edition, Prentice Hall

24. Shapiro, H.I., Shapiro, J.P., Shapiro, L.K.
(2000) *Cranes and Derricks*. Cited 22 times.
3rd Ed, McGraw-Hill, New York

25. (2007)
Simlog

26. Sivakumar, P.L., Varghese, K., Ramesh Babu, N.
Automated path planning of cooperative crane lifts using heuristic search
(2003) *Journal of Computing in Civil Engineering*, 17 (3), pp. 197-207. Cited 14 times.
doi: 10.1061/(ASCE)0887-3801(2003)17:3(197)

27. Spong, M.W., Lewis, F.L., Abdallah, C.T.
Robot Control - Dynamics, Motion Planning, and Analysis

(1992) *IEEE Press, IEEE Control Systems Society*

28. Wing, R.
RFID applications in construction and facilities management
(2006) *Electronic Journal of Information Technology in Construction*, 11, pp. 711-721. Cited 7 times.
http://www.itcon.org/data/works/att/2006_50.content.06353.pdf

29. (2008)
WorkSafeBC
http://worksafebc.com

30. Zaki, A.R., Mailhot, G.
Deck Reconstruction of Jacques Cartier Bridge Using Precast Prestressed High Performance Concrete Panels
(2003) *PCI Journal*, 48 (5), pp. 20-33. Cited 10 times.

31. Zhang, C., Hammad, A., Zayed, T.M., Wainer, G., Pang, H.
Cell-based representation and analysis of spatial resources in construction simulation
(2007) *Automation in Construction*, 16 (4), pp. 436-448. Cited 3 times.
doi: 10.1016/j.autcon.2006.07.009

32. Zhang, C., Hammad, A., AlBahnassi, H.
(2009) *Path Re-planning of Cranes Using Real-time Location System (Under reviewing for the 26th International Symposium on Automation & Robotics in Construction, ISARC2009)*

33. Zhang, C., Hammad, A. and AlBahnassi, H. 2009b. Collaborative Multi-agent Systems for Construction Equipment Based on Real-time Field Data Capturing. Next Generation Construction IT: Technology Foresight, Future Studies, Roadmapping, and Scenario Planning (accepted).

Zhang, C.; Building, Civil and Environmental Engineering Department, Concordia University, Montreal, QC, Canada

Proceedings, Annual Conference - Canadian Society for Civil Engineering
Volume 3, 2009, Pages 1256-1265