Curriculum Vitae
Gianni A. Di Caro

- Family, First and Middle Name: Di Caro, Gianni Andrea
- Nationality: Italian
- Affiliation: Carnegie Mellon University (CMU)
  Dept. of Computer Science, Qatar Campus, Doha
- Position: Associate Teaching Professor
- Main domains of interest: Swarm intelligence, Multi-robot systems, Optimization, AI
- E-mail, Web page: `gdicaro AT cmu DOT edu`, `http://www.giannidicaro.com`
- Total citations / H-index / i10-index : 25,000 / 33 / 68 (Source: *Google Scholar*)

Contents

1 Education

- ***Doctorate*, with Full Honors - 11/2004**
  INSTITUTION: Faculty of Applied Sciences, Université Libre de Bruxelles (ULB), Brussels, Belgium
  DISSERTATION: *Ant Colony Optimization and its application to adaptive routing in telecommunication networks*
  SUPERVISOR: Prof. M. Dorigo, FNRS & IRIDIA

- ***Diplôme d'Études Approfondies (D.E.A.)* (Master of Applied Sciences) - 05/2001**
  INSTITUTION: Faculty of Applied Sciences, Université Libre de Bruxelles, Brussels, Belgium
  DISSERTATION: *A society of ant-like agents for adaptive routing in networks*
  SUPERVISOR: Prof. M. Dorigo, FNRS & IRIDIA

- ***Laurea in Physics* (B.S. + MSc. equivalent), Summa Cum Laude - 03/1992**
  INSTITUTION: Faculty of Mathematical and Physical Sciences, University of Bologna, Bologna, Italy
  DISSERTATION: *Implementation of a transputer-based system for real-time parallel data acquisition and the online control of large-scale particle physics detectors* (in Italian)
  SUPERVISORS: Prof. R. Campanini and Dr. I. D'Antone, Department of Physics, Bologna

2 Employment: Academic and Research Positions

1. **Associate Teaching Professor [08/2016 - 07/2019]**
   INSTITUTION: *Carnegie Mellon University (CMU), CS Department - Qatar Campus*
   ACTIVITIES: Teaching in the domains of robotics and artificial intelligence, research in related domains with a focus on swarm and multi-robot systems and on the application of AI to robotic scenarios.

2. **Senior Researcher, permanent position [03/2010 - 08/2016]**
   INSTITUTION: *"Dalle Molle" Institute for Artificial Intelligence (IDSIA), Lugano (CH)*
   ACTIVITIES: Research, teaching, and project writing in the domains of networking, swarm robotics, swarm intelligence, human-robot interaction, coordination and cooperation in multi-agent systems, ambient assisted living, autonomous robotics, combinatorial optimization, smart grids.

3. **Post-Doctoral Researcher [10/2006 - 03/2010]**
   INSTITUTION: *"Dalle Molle" Institute for Artificial Intelligence (IDSIA), Lugano (CH)*
   RESEARCH: Design and control of an innovative robotic system made of a swarm of heterogeneous autonomous robots acting and interacting in the full 3D space (EU-funded FET project *Swarmanoid*).

4. **Post-Doctoral Researcher [05/2003 - 09/2006]**
   INSTITUTION: *"Dalle Molle" Institute for Artificial Intelligence (IDSIA), Lugano (CH)*
   RESEARCH: Study of nature's complex adaptive systems to design robust self-organizing systems for optimization and control in peer-to-peer and mobile ad-hoc networks (EU-funded FET project *BISON*).

5. ***Marie Curie* Postdoc Fellow [11/2001 - 04/2003]**
   INSTITUTION: *IRIDIA, Université Libre de Bruxelles (ULB), Brussels (Belgium)*
   RESEARCH: Application of artificial intelligence techniques for control and optimization in telecommunication networks, modeling of complex biological systems.

6. **Research Assistant for *Japan Science and Technology Corporation (JST)* [01/2001 - 09/2001]**
   INSTITUTION: *Advanced Telecommunications Research (ATR), Kyoto (Japan)*
   RESEARCH: Brain modeling, reinforcement learning in partially observable environments, adaptive setting of meta-parameters for learning algorithms, multi-agent learning.

7. ***Science and Technology in Japan* Fellow [02/1999 - 11/2000]**
   Institution: *HIP Labs, Advanced Telecommunications Research (ATR), Kyoto (Japan)*
   Research: Distributed multi-agent algorithms for sequential decision making in partially observable environments, modeling and simulation of the human immune system.

8. ***TMR - Marie Curie* Fellow [08/1996 - 02/1999]**
   Institution: *IRIDIA, Université Libre de Bruxelles (ULB), Brussels (Belgium)*
   Research: Reinforcement learning algorithms for distributed and partially observable environments, applications to adaptive routing and load balancing in telecommunication networks.

9. **Research Assistant [03/1996 - 06/1996]**
   Institution: *Department of Biomedical Sciences, University of Modena, Modena (Italy)*
   Research: Modeling of biological and evolutionary systems, management of local computing resources.

10. **Research Consultant [12/1995 - 02/1996]**
    Institution: *Istituto per la Ricerca Scientifica e Tecnologica (IRST), Trento (Italy)*
    Research: Software integration and design of architectures for autonomous robot programming.

11. **Research Assistant [01/1995 - 12/1995]**
    Institution: *Department of Mathematics, University of Trento, Trento (Italy)*
    Research: Development of heuristic algorithms for combinatorial optimization, administration of Unix systems and web sites, application of image processing and software engineering techniques.

12. **Post-Graduate Research Fellow [01/1994 - 12/1994]**
    Institution: *IRST, Trento (Italy)*
    Research: Implementation of a real-time stereoscopic vision system for autonomous robotic navigation using a parallel network of digital signal processors.

13. **Post-Graduate Research Fellow [07/1993 - 12/1993]**
    Institution: *IRST, Trento (Italy)*
    Research: Design and realization of a concurrent real-time software architecture for the management of the activities of a mobile autonomous robot equipped with multiple sensors.

14. **Graduate Research Assistant [04/1992 - 07/1993]**
    Institution: *Department of Physics, University of Bologna, Bologna (Italy)*
    Research: Parallel implementations of genetic algorithms for optimization, application of fuzzy logic and classical pattern recognition techniques to the discrimination of sub-atomic particle beams.

3 Scientific Publications

3.1 Books

1. G. A. Di Caro and G. Theraulaz, editors. **Bio-Inspired Models of Network, Information, and Computing Systems - Proceedings of the 7th BIONETICS International Conference, 2012**, volume 134 of *LNICST*. Springer, 2014. Lugano, Switzerland, December 10–11, 2012.

2. C. Di Chio, A. Agapitos, S. Cagnoni, C. Cotta, F. Fernández de Vega, G. A. Di Caro, R. Drechsler, A. Ekárt, A. Esparcia-Alcázar, M. Farooq, W.B. Langdon, J.-J. Merelo-Guervós, M. Preuss, H. Richter, S. Silva, A. Simoes, G. Squillero, E. Tarantino, A. Tettamanzi, J. Togelius, N. Urquhart, A. Şima Uyar, and G. Yannakakis, editors. **Applications of Evolutionary Computation - Proceedings of EvoApplications 2012: EvoCOMNET, EvoCOMPLEX, EvoFIN, EvoGAMES, EvoHOT, EvoIASP, EvoNUM, EvoPAR, EvoRISK, EvoSTIM, and EvoSTOC**, volume 7248 of *LNCS*. Springer, 2012. Malaga, Spain, April 11–13, 2012.

3. C. Di Chio, A. Brabazon, G.A. Di Caro, R. Drechsler, M. Farooq, J. Grahl, G. Greenfield, C. Prins, J. Romero, G. Squillero, E. Tarantino, A. Tettamanzi, N. Urquhart, and A.S. Uyar, editors. **Applications of Evolutionary Computation - Proceedings of EvoApplications 2011, Part II: EvoCOMNET, EvoFIN, EvoHOT, EvoMUSART, EvoSTIM, and EvoTRANSLOG**, volume 6625 of *LNCS*. Springer, 2011. Turin, Italy, April 27–29, 2011.

4. M. Dorigo, M. Birattari, G.A. Di Caro, R. Doursat, A. Engelbrecht, D. Floreano, L.M. Gambardella, R. Groß, E. Sahin, H. Sayama, and T. Stützle, editors. **Swarm Intelligence, Proceedings of the 7th International Conference ANTS 2010**, volume 6234 of *LNCS*. Springer, 2010. Brussels, Belgium, September 8–10, 2010.

5. C. Di Chio, A. Brabazon, G.A. Di Caro, M. Ebner, M. Farooq, A. Fink, J. Grahl, G. Greenfield, P. Machado, M. O'Neill, E. Tarantino, and N. Urquhart, editors. **Proceedings of EvoApplications 2010: EvoCOMNET, EvoENVIRONMENT, EvoFIN, EvoMUSART, and EvoTRANSLOG**, volume 6025 of *LNCS*. Springer, 2010. Istanbul, Turkey, April 7–9, 2010.

6. M. Giacobini, A. Brabazon, S. Cagnoni, G.A. Di Caro, R. Drechsler, A. Ekart, A. Esparcia-Alcazar, M. Farooq, A. Fink, J. McCormack, M. O'Neill, J. Romero, F. Rothlauf, G. Squillero, A.S. Uyar, and S. Yang, editors. **Proceedings of EvoWorkshops 2008: EvoCOMNET, EvoENVIRONMENT, EvoFIN, EvoGAMES, EvoHOT, EvoIASP, EvoINTERACTION, EvoMUSART, EvoNUM, EvoPhD, EvoSTOC, and EvoTRANSLOG**, volume 5484 of *LNCS*. Springer, 2009. Tübingen, Germany, April 15–17, 2009.

7. M. Giacobini, A. Brabazon, S. Cagnoni, G.A. Di Caro, R. Drechsler, A. Ekart, A. Esparcia-Alcazar, M. Farooq, A. Fink, J. McCormack, M. O'Neill, J. Romero, F. Rothlauf, G. Squillero, A.S. Uyar, and S. Yang, editors. **Proceedings of EvoWorkshops 2008: EvoCOMNET, EvoFIN, EvoHOT, EvoIASP, EvoMUSART, EvoNUM, EvoSTOC, and EvoTRANSLOG**, volume 4974 of *LNCS*. Springer, 2008. Naples, Italy, March 26–28, 2008.

8. M. Giacobini, A. Brabazon, S. Cagnoni, G. A. Di Caro, R. Drechsler, A. Ekart, , M. Farooq, A. Fink, , E. Lutton, P. Machado, S. Minner, M. O'Neill, J. Romero, F. Rothlauf, G. Squillero, H. Takagi, A.S. Uyar, and S. Yang, editors. **Proceedings of EvoWorkshops 2007: EvoCOMNET, EvoFIN, EvoIASP, EvoINTERACTION, EvoMUSART, EvoSTOC, and EvoTRANSLOG**, volume 4448 of *LNCS*. Springer, 2007.

9. M. Dorigo, G.A. Di Caro, and M. Sampels, editors. **Ant Algorithms - Proceedings of ANTS 2002, Third International Workshop on Ant Algorithms, Brussels, Belgium, September 12–14, 2002**, volume 2463 of *LNCS*. Springer-Verlag, 2002.

3.2 Chapters in Books

1. G.A. Di Caro, F. Ducatelle, and L.M. Gambardella. *Routage dans les réseaux mobiles ad hoc en environnement urbain (in French, "Routing in urban mobile ad hoc networks")*. In N. Monmarché, F. Guinand, and P. Siarry, editors, **Fourmis artificielles 2, nouvelles directions pour une intelligence collective**. Hermès Science Publications, France, 2009.

2. G.A. Di Caro, F. Ducatelle, and L.M. Gambardella. *Routing in urban mobile ad hoc networks (translated and reprinted from Hermès Science Publications).* In N. Monmarché, F. Guinand, and P. Siarry, editors, **Artificial ants**, page 576. Wiley-ISTE, 2010.

3. M. Farooq and G.A. Di Caro. *Routing protocols for next generation networks inspired by collective behaviors of insect societies: An overview.* In C. Blum and D. Merckle, editors, **Swarm Intelligence: Introduction and Applications**, Natural Computing. Springer, 2008.

4. G.A. Di Caro, F. Ducatelle, and L.M. Gambardella. *Theory and practice of Ant Colony Optimization for routing in dynamic telecommunications networks.* In N. Sala and F. Orsucci, editors, **Reflecting interfaces: the complex coevolution of information technology ecosystems**, pages 185–216. Idea Group, Hershey, USA, 2008.

5. M. Dorigo and G.A. Di Caro. *The ant colony optimization meta-heuristic.* In D. Corne, M. Dorigo, and F. Glover, editors, **New Ideas in Optimization**, pages 11–32. McGraw-Hill, 1999.

3.3 Refereed Journal Papers - Published

1. J. Banfi, J. Guzzi, , F. Amigoni, E. Feo-Flushing, A. Giusti, L. Gambardella, and G. A. Di Caro. *An integer linear programming model for fair multitarget tracking in cooperative multirobot systems.* ***Autonomous Robots***, 2018. DOI: https://link.springer.com/article/10.1007/s10514-018-9735-4.

2. R. Magán-Carrión, J. Camacho, P. Garcia-Teodoro, E. Feo-Flushing, and G. A. Di Caro. *A dynamical relay node placement solution for MANETs.* ***Computer Communications***, 114:36–50, Elsevier, December 2017.

3. A. Giusti, J. Guzzi, D. Ciresan, F. Lin, J. P. Rodríguez, F. Fontana, M. Faessler, C. Forster, J. Schmidhuber, G. A. Di Caro, D. Scaramuzza, and L. Gambardella. *A machine learning approach to the visual perception of forest trails for mobile robots.* ***IEEE Robotics and Automation Letters***, 1(2):661–667, IEEE RAS, 2016.

4. G. A. Di Caro. *Principi di swarm intelligence per problemi di routing adattivo in reti di telecomunicazione.* ***Sistemi Intelligenti***, 26(3):443–464, Il Mulino, December 2014. [In Italian].

5. A. Reina, L. M. Gambardella, M. Dorigo, and G. A. Di Caro. *zePPeLIN: Distributed path planning using an overhead camera network.* ***International Journal of Advanced Robotic Systems***, 11(119):1–22, InTech, 2014.

6. F. Ducatelle, G. A. Di Caro, A. Förster, M. Bonani, M. Dorigo, S. Magnenat, F. Mondada, R. O'Grady, C. Pinciroli, P. Rétornaz, V. Trianni, and L. M. Gambardella. *Cooperative navigation in robotic swarms.* ***Swarm Intelligence***, 8(1):1–33, Springer, 2014.

7. A. Giusti, M. Salani, G. A. Di Caro, A. E. Rizzoli, and L. M. Gambardella. *Restricted neighborhood communication improves decentralized demand-side load management.* ***IEEE Transactions on Smart Grid***, 5(1):92–101, IEEE, January 2014.

8. M. Dorigo, D. Floreano, L. M. Gambardella, F. Mondada, S. Nolfi, T. Baaboura, M. Birattari, M. Bonani, M. Brambilla, A. Brutschy, D. Burnier, A. Campo, A. L. Christensen, A. Decugnière, G. A. Di Caro, F. Ducatelle, E. Ferrante, A. Förster, J. Guzzi, V. Longchamp, S. Magnenat, J. Martinez Gonzales, N. Mathews, M. Montes de Oca, R. O'Grady, C. Pinciroli, G. Pini, P. Rétornaz, J. Roberts, V. Sperati, T. Stirling, A. Stranieri, T. Stützle, V. Trianni, E. Tuci, A. E. Turgut, and F. Vaussard. *Swarmanoid: A novel concept for the study of heterogeneous robotic swarms.* ***IEEE Robotics & Automation Magazine***, 20(4):60–71, IEEE RAS, 2013.

9. M. Kudelski, L. M. Gambardella, and G. A. Di Caro. *RoboNetSim: An integrated framework for multi-robot and network simulation.* ***Robotics and Autonomous Systems***, 61(5):483–496, Elsevier, 2013.

10. R. Montemanni, M. Mojana, G. A. Di Caro, and L. M. Gambardella. *A decomposition-based exact approach for the sequential ordering problem.* ***Journal of Applied Operational Research (JAOR)***, 5(1):2–13, ORLab, 2013.

11. C. Pinciroli, V. Trianni, R. O'Grady, G. Pini, A. Brutschy, M. Brambilla, N. Mathews, E. Ferrante, G. A. Di Caro, F. Ducatelle, M. Birattari, L. M. Gambardella, and M. Dorigo. *ARGoS: A modular, parallel, multi-engine simulator for multi-robot systems.* ***Swarm Intelligence***, 6(4):271–295, Springer, 2012.

12. F. Ducatelle, G.A. Di Caro, C. Pinciroli, and L. Gambardella. *Self-organized cooperation between robotic swarms.* ***Swarm Intelligence***, 5(2):73–96, Springer, 2011.

13. M. Saleem, G.A. Di Caro, , and M. Farooq. *A review of swarm intelligence based routing protocols for wireless sensor networks.* ***Information Sciences***, 181(20):4597–4624, Elsevier, October 2011.

14. F. Ducatelle, G.A. Di Caro, and L. Gambardella. *Principles and applications of swarm intelligence for adaptive routing in telecommunications networks.* ***Swarm Intelligence***, 4(3):173–198, Springer, 2010.

15. G. A. Di Caro, S. Giordano, M. Kulig, D. Lenzarini, A. Puiatti, F. Schwitter, and S. Vanini. *Deployable application layer solution for seamless mobility across heterogeneous networks.* ***Ad Hoc & Sensor Wireless Networks***, 4(1–2):1–42, Old City Publishing, 2007.

16. O. Babaoglu, G. Canright, A. Deutsch, G.A. Di Caro, F. Ducatelle, L.M. Gambardella, N. Ganguly, M. Jelasity, R. Montemanni, A. Montresor, and T. Urnes. *Design patterns from biology for distributed computing.* ***ACM Transactions on Autonomous and Adaptive Systems (TAAS)***, 1(1), ACM Press, September 2006.

17. G.A. Di Caro, F. Ducatelle, L.M. Gambardella, and A. Rizzoli. *Building blocks from biology for the design of algorithms for the management of modern dynamic networks.* ***European Research Consortium for Informatics and Mathematics (ERCIM) News,*** **Special Issue on Swarm Intelligence**, 64, ERCIM, January 2006.

18. G.A. Di Caro, F. Ducatelle, and L.M. Gambardella. *BISON: Biologically-inspired techniques for self-organization in dynamic networks.* ***Kuenstliche Intelligenz,*** **Special Issue on Swarm Intelligence**, 4:36–39, Springer, November 2005.

19. F. Ducatelle, G.A. Di Caro, and L.M. Gambardella. *Using ant agents to combine reactive and proactive strategies for routing in mobile ad hoc networks.* ***International Journal of Computational Intelligence and Applications,*** **Special Issue on Nature-Inspired Approaches to Networks and Telecommunications**, 5(2):169–184, World Scientific, June 2005.

20. G.A. Di Caro, F. Ducatelle, and L.M. Gambardella. *AntHocNet: an adaptive nature-inspired algorithm for routing in mobile ad hoc networks.* ***European Transactions on Telecommunications***, 16(5):443–455, Wiley-Blackwell, 2005.

21. G.A. Di Caro and M. Dorigo. *AntNet: Distributed stigmergetic control for communications networks.* ***A Quarterly in Artificial Intelligence***, 12(3 & 4):2–37, Vivek Publication, 1999. JAIR reprint.

22. M. Dorigo, G.A. Di Caro, and L. M. Gambardella. *Ant algorithms for discrete optimization.* ***Artificial Life***, 5(2):137–172, MIT Press, 1999.

23. G.A. Di Caro and M. Dorigo. *AntNet: Distributed stigmergetic control for communications networks.* ***Journal of Artificial Intelligence Research (JAIR)***, 9:317–365, AI Access Foundation, 1998.

24. F. Valentinotti, G.A. Di Caro, and B. Crespi. *Real-time parallel computation of disparity and optical flow using phase difference.* ***Machine Vision and Applications***, 9(3):87–96, Springer, 1996.

25. R. Campanini, G.A. Di Caro, M. Villani, I. D'Antone, and G. Giusti. *Parallel architectures and intrinsically parallel algorithms: Genetic algorithms.* ***International Journal of Modern Physics C***, 5(1):95–112, World Scientific, 1994.

26. R. Campanini, I. D'Antone, G.A. Di Caro, and G. Giusti. *A transputer-based parallel expert diagnostic system.* ***Parallel Computing***, 19(6):685–692, Elsevier, 1993.

3.4 Refereed Conference/Workshop Papers

1. J. Guzzi, A. Giusti, L. Gambardella, and G. A. Di Caro. *A model of artificial emotions for behavior-modulation and implicit coordination in multi-robot systems.* In **Proceedings of the Genetic and Evolutionary Computation Conference (GECCO)**, Kyoto, Japan, July 15–19, 2018 (to be published).

2. J. Guzzi, A. Giusti, J. Nagi, L. Gambardella, and G. A. Di Caro. *Artificial emotions as dynamic modulators of individual and group behavior in multi-robot system* (Extended abstract). In **Proceedings of the 17th International Conference on Autonomous Agents and Multiagent Systems (AAMAS)**, Stockholm, Sweden, July 10–15, 2018 (to be published).

3. A. Giusti, J. Guzzi, G. A. Di Caro, and L. M. Gambardella. *Mighty Thymio for robotics education* (poster). In **Proceedings of the 8th AAAI Symposium on Educational Advances in Artificial Intelligence (EAAI-18)**, New Orleans, USA, February 2–5, 2018.

4. E. Feo-Flushing, L. Gambardella, and G. A. Di Caro. *Simultaneous spatial task allocation, data routing and transmission scheduling in mobile multi-robot teams.* In **Proceedings of the 30th IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)**, pages 1861–1868, Vancouver, Canada, September 24–28, 2017.

5. B. Gromov, L. Gambardella, and G. A. Di Caro. *Wearable multi-modal interface for human multi-robot interaction.* In **Proceedings of the 14th IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR)**, pages 240–245, Lausanne, Switzerland, October 23–27, 2016.

6. E. Feo-Flushing, L. Gambardella, and G. A. Di Caro. *Robot rostering: Coalition formation for long-term missions with work shifts.* In **Proceedings of the 14th IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR)**, pages 334–341, Lausanne, Switzerland, October 23–27, 2016.

7. E. Feo-Flushing, L. Gambardella, and G. A. Di Caro. *On using mobile robotic relays for supporting data communications in search and rescue missions.* In **Proceedings of the 14th IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR)**, pages 370–377, Lausanne, Switzerland, October 23–27, 2016.

8. L. Gambardella E. Feo-Flushing and G. A. Di Caro. *A two-tier wireless ad hoc network for multi-robot monitoring and control.* In **(Demonstration session) Proceedings of the 14th IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR)**, Lausanne, Switzerland, October 23–27, 2016.

9. J. Guzzi and G. A. Di Caro. *From indoor GIS maps to path planning for autonomous wheelchairs.* In **Proceedings of the 29th IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)**, pages 4773–4779, Daejeon, South Korea, October 9–14, 2016.

10. B. Gromov, L. Gambardella, and G. A. Di Caro. *Wearable multi-modal interfaces for mixed-initiative interaction in human multi-robot teams.* In **ICRA Workshop on Fielded Multi-robot systems operating on land, sea, and air (Poster with extended abstract)**, Stockholm, Sweden, May 20, 2016.

11. R. Magán-Carrión, J. Camacho, P. Garcia-Teodoro, E. Feo-Flushing, and G. A. Di Caro. *Drns: Dynamical relay node placement solution.* In LNCS Springer, editor, **Proceedings of the 14th International Conference on Practical Applications of Agents and Multi-Agent Systems (PAAMS) – Demonstrations Track**, Sevilla, Spain, June 1–3, 2016.

12. E. Feo-Flushing, L. Gambardella, and G. A. Di Caro. *On decentralized coordination for spatial task allocation and scheduling in heterogeneous teams.* In **Proceedings of the 15th International Conference on Autonomous Agents and Multiagent Systems (AAMAS)**, pages 988–996, Singapore, May 9–13, 2016.

13. A. Giusti, J. Guzzi, D. Ciresan, F.-L. He, J. P. Rodriguez, F. Fontana, M. Faessler, C. Forster, J. Schmidhuber, G. A. Di Caro, D. Scaramuzza, and L. M. Gambardella. *A machine learning approach to visual perception of forest trails for mobile robots.* In **Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)**, Stockholm, Sweden, May 16–21, 2016.

14. J. Guzzi and G. A. Di Caro. *Towards supporting elderly's orientation, mobility, and autonomy.* In **Workshop on Improving the quality of life in the elderly using robotic assistive technology: benefits, limitations, and challenges - International Conference on Social Robotics (ICSR)**, Paris, France, October 30, 2015.

15. A. Giusti, J. Guzzi, D. Ciresan, F. Lin, J. P. Rodríguez, F. Fontana, M. Faessler, C. Forster, J. Schmidhuber, G. A. Di Caro, D. Scaramuzza, and L. Gambardella. *A machine learning approach to the visual perception of forest trails.* In **IROS Workshop on Vision-based Control and Navigation of Small, Lightweight UAVs**, Hamburg, Germany, October 2, 2015.

16. R. Magán-Carrión, J. Camacho, P. Garcia-Teodoro, E. Feo-Flushing, and G. A. Di Caro. *Dynamical relay node placement solution in MANETs.* In **Proceedings of the 3rd IEEE International Black Sea Conference on Communications and Networking (BlackSeaCom), Demonstration Session**, Constanta, Romania, May 18–21, 2015.

17. J. Banfi, J. Guzzi, A. Giusti, L. Gambardella, and G. A. Di Caro. *Fair multi-target tracking in cooperative multi-robot systems.* In **Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)**, pages 5411–5418, Seattle, USA, May 26 – 30, 2015.

18. J. Nagi, H. Ngo, L. Gambardella, and G. A. Di Caro. *Wisdom of the swarm for human-swarm interaction.* In **Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)**, pages 1802–1808, Seattle, USA, May 26 – 30, 2015.

19. J. Nagi, F. Nagi, A. Giusti, L. Gambardella, and G. A. Di Caro. *Human-swarm localization: online learning of symmetric face poses.* In **Proceedings of the IEEE International Conference on Image Processing (ICIP)**, Paris, France, October 27–30, 2014.

20. E. Feo-Flushing, L. Gambardella, and G. A. Di Caro. *A mathematical programming approach to collaborative missions with heterogeneous teams.* In **Proceedings of the 27th IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)**, pages 396–403, Chicago, IL, USA, September 14–18, 2014.

21. J. Nagi, A. Giusti, L. Gambardella, and G. A. Di Caro. *Human-swarm interaction using spatial gestures.* In **Proceedings of the 27th IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)**, pages 3834–3841, Chicago, IL, USA, September 14–18, 2014.

22. F. Ghiringhelli, A. Giusti, J. Guzzi, G. A. Di Caro, V. Caglioti, and L. Gambardella. *Interactive augmented reality for understanding and analyzing multi-robot systems.* In **Proceedings of the 27th IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)**, pages 1195–1201, Chicago, IL, USA, September 14–18, 2014.

23. A. Pesenti Gritti, O. Tarabini, A. Giusti, J. Guzzi, G. A. Di Caro, V. Caglioti, and L. Gambardella. *Kinect-based people detection and tracking from small-footprint ground robots.* In **Proceedings of the 27th IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)**, pages 4096–4103, Chicago, IL, USA, September 14–18, 2014.

24. E. Feo-Flushing, M. Kudelski, L. Gambardella, and G. A. Di Caro. *Spatial prediction of wireless links and its application to the path control of mobile robots.* In **Proceedings of the 9th IEEE International Symposium on Industrial Embedded Systems (SIES)**, pages 218–227, Pisa, Italy, June 18–20, 2014.

25. G. A. Di Caro, E. Feo-Flushing, and L. Gambardella. *Use of time-dependent spatial maps of communication quality for network-aware multi-robot path planning.* In **Proceedings of the 8th International Workshop on Wireless Sensor, Actuator and Robot Networks (WiSARN)**, Benidorm, Spain, June 22–27, 2014.

26. M. Kudelski, L. Gambardella, and G. A. Di Caro. *A mobility-controlled link quality learning protocol for multi-robot coordination tasks.* In **Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)**, pages 5024–5032, Hong Kong, China, May 31 – June 5, 2014.

27. J. Nagi, A. Giusti, F. Nagi, L. Gambardella, and G. A. Di Caro. *Online feature extraction for the incremental learning of gestures in human-swarm interaction.* In **Proceedings of the IEEE International Conference on Robotics and Automation (ICRA)**, pages 3331–3338, Hong Kong, China, May 31 – June 5, 2014.

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3.5 Unpublished Technical Reports

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5. G.A. Di Caro. *Analysis of simulation environments for mobile ad hoc networks.* Technical Report 24-03, IDSIA, Lugano, (Switzerland), December 2003.

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9. G.A. Di Caro and M. Dorigo. *AntNet: A mobile agents approach to adaptive routing.* Technical Report 97–12, IRIDIA, Université Libre de Bruxelles, Brussels, Belgium, June 1997.

10. G.A. Di Caro. *ARCA: a Software Architecture to Program Robots.* Internal Report IRST, Istituto per la Ricerca Scientifica e Tecnologica, Trento, Italy, January 1996.

11. G.A. Di Caro. *Style and Organization Rules for the Development of C Programs.* Technical Report UTM-462, Department of Mathematics, University of Trento, Trento, Italy, May 1995.

3.6 Refereed Video Productions

1. SWARMIX project team (`www.swarmix.org`). *Finding Linda - A Search and Rescue Mission by SWARMIX.* In **Proceedings of the 10th AAAI Video Competition**, Phoenix, AR, USA, February 12–17, 2016. (**Most Entertaining Video award**, and **Nominated for Best Video and Best Robot Video awards**).

2. A. Giusti, J. Guzzi, D. Ciresan, F.-L. He, J. P. Rodriguez, G. A. Di Caro, J. Schmidhuber, L. M. Gambardella, F. Fontana, M. Faessler, C. Forster, and D. Scaramuzza. *Quadcopter navigation in the forest.* In **Proceedings of the 10th AAAI Video Competition**, Phoenix, AR, USA, February 12–17, 2016. (**Nominated for Best Robot Video award**).

3. SWARMANOID project team (`www.swarmanoid.org`). *Swarmanoid, the movie.* In **Proceedings of the 5th AAAI Video Competition**, San Francisco, CA, USA, August 7–11, 2011. (**Best video award**).

4 Evidence of External Reputation

4.1 Citations and Awards

- **Total citations:** 25,000 (Source: GoogleScholar)
- **H-index:** 33 (Source: GoogleScholar)
- **Most entertaining video award, and nomination for for best video and best robot video awards at the *10th AAAI Video Competition***, Phoenix, February 12–17, 2016. Awarded to the video: *Finding Linda - A Search and Rescue Mission by SWARMIX*, SWARMIX project team.
- **Nomination for best video award at the *10th AAAI Video Competition***, Phoenix, February 12–17, 2016. Awarded to the video: *Quadcopter Navigation in The Forest*, A. Giusti, J. Guzzi, D. Ciresan, F.-L. He, J. P. Rodriguez, G. A. Di Caro, J. Schmidhuber, L. M. Gambardella, F. Fontana, M. Faessler, C. Forster, D. Scaramuzza.
- **Nomination for best conference paper at the *11th IEEE Int. Symposium on Safety, Security, and Rescue Robotics (SSRR)***, Linköping, Sweden, Oct. 21–26, 2013. Awarded to paper: *Connectivity-aware planning of search and rescue missions*, E. Feo, M. Kudelski, L. Gambardella, G. A. Di Caro.
- **Best paper at the *7th Int. Conf. on Bio-Inspired Models of Network, Information, and Computing Systems (BIONETICS)***, Lugano, CH, Dec. 10–11, 2012. Awarded to paper: *Bioinspired obstacle avoidance algorithms for robot swarms*, J. Guzzi, A. Giusti, L. Gambardella, G. A. Di Caro.
- **Best research paper at the *2nd Annual International Conference on Advanced Topics in Artificial Intelligence (ATAI)***, Singapore, November 24–25, 2011. Awarded to paper: *An algorithm combining linear programming and an ant system for the sequential ordering problem*, M. Mojana, R. Montemanni, G.A. Di Caro and L.M. Gambardella.
- **Best video award at the *5th AAAI Video Competition***, San Francisco, August 7–11, 2011. Awarded to the video: *Swarmanoid, The Movie*, Swarmanoid project team.
- **Best conference poster at the *12th Conference Towards Autonomous Robotic Systems (TAROS)***, Sheffield, UK, August 31 – September 2, 2011. Awarded to paper: *Distributed motion planning for ground objects using a network of robotic ceiling cameras*, A. Reina, G.A. Di Caro, F. Ducatelle, L.M. Gambardella.
- **Best conference paper at the *8th International Conf. on Parallel Problem Solving from Nature (PPSN VIII)***, Birmingham, UK, 18–22 September 2004. Awarded to paper: *AntHocNet: an Ant-Based Hybrid Routing Algorithm for Mobile Ad Hoc Networks*, G. Di Caro, F. Ducatelle and L.M. Gambardella.

4.2 Invited Talks

- Invited keynote talk: *Robot Swarms: The human-in-the-loop*, at **Lakeside Labs Research Days 2017 on Self-organization and Swarm Intelligence in Cyber-Physical systems**, Klagenfurt, Austria July 10–12, 2017.
- Invited talk: *Interaction, communication, and control in mixed teams of robot swarms and human agents*, at the techno-managerial festival **Pragyan '16, National Institute of Technology Tiruchirappalli (NIT-T), India**, February 27, 2016.
- Invited talk: *Swarm intelligence in the physical world*, at the techno-managerial festival **Technex'16, Indian Institute of Technology (BHU) Varanasi, India**, March 4, 2016.

- Invited talk: *Adaptive mission planning in mixed swarms*, **Navigare Workshop: Cooperative and Swarm Navigation**, Thun, Switzerland, organized by Swiss Institute of Navigation & Armasuisse, May, 2015.

- Invited talks: *Swarm intelligence and mixed (robot) teams: Interaction, communication, and control*, at the **Indian Institutes of Technology (IIT) of Delhi, Kharagpur, and Roorkee**, tour organized by Swissnex India and Swiss Embassy in India, January 30 – February 6, 2015.

- Invited kyenote talk: *Collaborative mission planning and adaptive control in heterogeneous networked teams*, **2nd AETOS International Conference on "Research challenges for future RPAS/UAV systems"**, Bordeaux, France, September 9–10, 2014.

- Invited talk: *Human-swarm interaction*, **Towards a Swiss Robotics Rescue Team, Workshop at the IEEE International Conference on Robotics and Automation (ICRA)**, Karlsruhe, Germany, May 6–10, 2013.

- Invited talk: *Power of the Swarm, in Natural, Simulation, and Robotic Worlds*, at the **International exhibition "Think Art–Act Science", San Francisco Art Institute**, September 23, 2011.

- Participation to the research presented in **Swarmanoid, The Movie**, winner of the AAAI-2011 Best Video Award, September 8th, 2011.

4.3 Seminars and Colloquia

- Special guest at the **TV science show "Il Giardino di Albert"**, on RSI 1, the official Italian-speaking broadcast TV of Switzerland, to talk about robotics, February 20th, 2012.

- Interviewed by **The Economist** magazine, for the article *Riders on a swarm*, about swarm intelligence technologies, published on August 12th, 2010.

- Interviewed by the **Reflex magazine** (an EPFL-sponsored publication), for the 82-pages special issue on "Les secrets de l'intelligence", published on May 2010.

5 External Professional Activities

5.1 Conferences and Workshops Committees: Chair

1. G. A. Di Caro, *BIONETICS: 7th International Conference on Bio-Inspired Models of Network, Information, and Computing Systems* Lugano, Switzerland, December 10–11, 2012.

2. E. Natalizio, T. Razafindralambo, G. A. Di Caro, *MC* ^{3} *2012: 1st International Workshop on Mobility and Communication for Cooperation and Coordination*, in conjunction with the "Int. Conference on Computing, Networking and Communications (ICNC 2012)", Maui, Hawaii, USA, January 30 – February 2, 2012.

3. G. A. Di Caro, M. Farooq and E. Tarantino, *EvoCOMNET: 9th European Event on the Application of Nature-inspired Techniques to Telecommunication Networks and other Parallel and Distributed Systems*, Malaga, Spain, April 11–13, 2012.

4. G. A. Di Caro, M. Farooq and E. Tarantino, *EvoCOMNET: 8th European Event on the Application of Nature-inspired Techniques to Telecommunication Networks and other Parallel and Distributed Systems*, Turin, Italy, April 27–29, 2011.

5. M. Dorigo, G.A. Di Caro, A. Engelbrecht, L. Gambardella and E. Sahin, *ANTS 2010, 7th International Conference on Swarm Intelligence*, Brussels, Belgium, September 8–10, 2010.

6. G. A. Di Caro, M. Farooq and E. Tarantino, *EvoCOMNET: 7th European Event on the Application of Nature-inspired Techniques to Telecommunication Networks and other Parallel and Distributed Systems*, Istanbul, Turkey, April 7–9, 2010.

7. G. A. Di Caro, M. Farooq and E. Tarantino, *EvoCOMNET: 6th European Workshop on the Application of Nature-inspired Techniques to Telecommunication Networks and other Parallel and Distributed Systems*, Tübingen, Germany, April 15-17, 2009.

8. G. A. Di Caro, F. Ducatelle, A. Forster, G. Venayagamoorthy, *5th IEEE Symposium on Swarm Intelligence, Special Session on: Swarm Intelligence for Wireless Ad Hoc Networks*, St. Louis, Missouri, USA, September 21–23, 2008.

9. G. A. Di Caro and M. Farooq, *EvoCOMNET: 5th European Workshop on the Application of Nature-inspired Techniques to Telecommunication Networks and other Connected Systems*, Naples, Italy, March 26–28, 2008.

10. G. A. Di Caro and M. Farooq, *EvoCOMNET: 4th European Workshop on the Application of Nature-inspired Techniques to Telecomm. Networks and other Connected Systems*, Valencia, Spain, April 11-13, 2007.

11. M. Dorigo, G.A. Di Caro, N. Sampels, *ANTS'02, 3rd International Workshop on Ant Algorithms*, Brussels, Belgium, September 12–14, 2002.

5.2 Conference and Workshop Committees: Associate Editor, PC Member, or Reviewer

(Incomplete list) PPSN V-VII, IEEE SIS 2005–2008, IEEE ICC 2007, DSN 2007, Bio-ADIT, GP 1998, AAMAS 2004, GECCO 2005-2015, ANTS 1998–2014, BIONETICS 2011-2012, IROS 2011-2014, IEEE IoT-SoS 2012, PPSN 2012, ICRA 2013-14, MobiCASE 2013, ALIFE 2014, PPSN 2014, DroNet 2015, TPNC 2015, ICRA 2016 and 2017 (Associate editor), ANTS2016

5.3 Memberships in Professional Societies

- IEEE Robotics and Automation Society

5.4 Editorial Board Memberships

- *Swarm Intelligence*, Springer

5.5 Editor of Journal Special Issues

1. E. Natalizio, G. Di Caro, A. Sekercioglu, E. Yanmaz, Eds., "Special issue on Theory, Algorithms and Applications of Wireless Networked Robotics", *Ad Hoc Networks*, Elsevier, Vol. 11, N. 7, 2013.

2. M. Dorigo, M. Birattari, G.A. Di Caro, R.Doursat, A. Engelbrecht, L.M. Gambardella, R. Groß, E. Sahin, T. Stützle, Eds., "Special issue of ANTS 2010", *Swarm Intelligence*, Springer, Vol. 5, N. 3–4, 2011.

3. M. Dorigo, G. A. Di Caro, T. Stützle, Guest Eds. "Special Issue on Ant Algorithms", *Future Generation Computer Systems (FGCS)*, Elsevier, Vol. 16, N. 8, 2000.

5.6 Journal Reviewer

(Incomplete list) IEEE Trans. on Systems, Man, and Cyb., Networks, Adaptive Behavior, IEEE Trans. on Evolutionary Comp., J. of Heuristics, Artificial Life, Swarm Intelligence J., Telecomm. Systems, European J. of Operational Research, J. of Networks, ACM Trans. on Internet Technology, J. of Systems Science, J. of System Architectures, J. of Computer Science, Computer Networks, ACM Trans. on Autonomous Adaptive Systems, Electronic and Telecomm. Research Institute J., Ad Hoc Networks, J. of Computational Intelligence and Applications, Sensors, European J. of Operations Research., IEEE Trans. on Robotics, Artificial Intelligence, Robotics and Autonomous Systems, Computational Intelligence.

5.7 External Expert for Research Projects

- Expert in swarm robotics in the External Stakeholders Group (ESG) for the EU-H2020 project *CPSwarm* (9 partners, 4.9M EUR funding, `https://www.cpswarm.eu/`)

6 Contract and Grant Support

6.1 Current

1. **Project:** ***Teams of Aquatic / Aerial Robots for Marine Environmental Monitoring.***
   Grant No: NPRP10-0213-170458

   Role: *Lead PI.*

   Funding agency: National Priority Research Program - Qatar National Research Foundation (QNRF).

   Amount: 600,000 USD.

   Duration: 3 years, from August 2018.

   Affiliation: CMU-Q.

   Partners: ISME (Integrated Systems for Marine Environment), Genova, Italy.

   Description: The project aims to integrate multiple aerial and water surface autonomous robots (UAVs, USVs) for cooperative missions in marine environments. Research focus is on: distributed planning and coordination exploiting complementary sensory-motor skills; integration of network control with mission-based decision-making; resilience to failures and hostile conditions; use of surface robots as carriers of aerial robots to support long-running missions; dynamic schedule of meeting points and takeoff and landing between UAVs and USVs.

6.2 Past Grant Support

1. **Projects:** ***(i) Symbiotic interaction between humans and multi-robot systems, (ii) Coalition-level team planning, (iii) Resilient path planning for ground robots.***
   Role: *Projects' Co-PI* with Luca Gambardella (IDSIA).

   Funding agency: Swiss National Science Foundation (SNSF) through the National Centre of Competence in Research (NCCR) Robotics, Phase 2.

   Amount: 600,000 CHF.

   Duration: 4 years, from 12/2014.

   Affiliation: Dalle Molle Institute for Artificial Intelligence (IDSIA).

   Description: The three projects are integral part of the nation-wide NCCR Robotics, Center of Excellence of Swiss NSF. In its Phase 2, the Center includes 18 research groups and is supported by a grant of more than 12M CHF (`www.nccr-robotics.ch`). IDSIA sub-projects address: multi-modal interaction and communication between humans and multiple robots; system-level planning in the space of the feasible coalitions that can be built in mixed human-robot teams; path planning models that are resilient to multiple local failures.

2. **Project:** ***ALMA: Ageing without Losing Mobility and Autonomy*** **[4/2013, 3.5 years]**.
   Role: *Project Coordinator and Principal Investigator (PI).*

   Funding agency: Ambient Assisted Living (AAL) - Scientific Institutions of the European Community.

   Amount: 1M CHF

   Duration: 3.5 years, from 4/2013.

   Affiliation: Dalle Molle Institute for Artificial Intelligence (IDSIA).

   Description: A total grant of 3M EUR. The consortium has included 8 partners (academic, industrial, and care-giving ones). The project (`www.alma-aal.org`) has resulted in a set of ambient intelligence and robotic technologies and their integration into a modular system aimed to support autonomous mobility, navigation, and orientation of the mobility-impaired person through the realization. Validation and testing of the developed technologies have been performed at real end-user institutions.

3. **Project:** ***Let's play together with robot swarms!***.

   Role: *Project Co-PI* with Luca Gambardella (IDSIA) and Francesco Mondada (EPFL).

   Funding agency: Swiss National Science Foundation (SNF) through the National Centre of Competence in Research (NCCR) Robotics, Phase 1.

   Amount: 100k CHF.

   Duration: 1 year, from 7/2013.

   Affiliation: Dalle Molle Institute for Artificial Intelligence (IDSIA).

   Description: Design and implemention of game scenarios, both in simulation and using real robots, to study strategies and modalities to let humans and multi-robot systems effectively team up. A game with multiple pursuers and evaders, including both humans and robots, was setup and demonstrated.

4. **Project:** ***SWARMIX: Synergistic Interactions in Swarms of Heterogeneous Agents***.

   Role: *Co-PI* with Luca Gambardella for IDSIA's research activities in the project.

   Funding agency: Swiss National Science Foundation (SNF), SINERGIA Program.

   Amount: 250k CHF.

   Duration: 3.5 years, from 2/2011.

   Affiliation: Dalle Molle Institute for Artificial Intelligence (IDSIA).

   Description: 1.1M CHF total grant funded by Swiss NSF, 4 research groups. IDSIA's research for the project addressed the study of adaptive planning and communication strategies for heterogeneous swarms, considering search and rescue scenarios and swarms composed of robots, humans, and dogs.

5. **Project:** ***Symbiotic human-swarm interaction and cooperation***.

   Role: *Co-PI* with Luca Gambardella for IDSIA's research activities in the project.

   Funding agency: Swiss National Science Foundation (SNF) through the National Centre of Competence in Research (NCCR) Robotics, Phase 1.

   Amount: 200k CHF.

   Duration: 4 years, from 12/2010.

   Affiliation: Dalle Molle Institute for Artificial Intelligence (IDSIA).

   Description: The sub-project was integral part of the large nation-wide NCCR Robotics, Center of Excellence of Swiss NSF, including 26 research groups in its Phase 1 and supported by a total grant of 13.3M CHF (`www.nccr-robotics.ch`). IDSIA's sub-project resulted in robust and scalable methods for the interaction, control, and coordination of heterogeneous symbiotic teams of multiple robots and humans.

6. **Project:** ***SWARMANOID: Towards Humanoid Robotic Swarms***.

   Role: *Co-PI* with Luca Gambardella for IDSIA's research activities in the project.

   Funding agency: FP6 FET Open programme - Scientific Institutions of the European Community.

   Amount: 600k CHF.

   Duration: 4 years, from 1/2006.

   Affiliation: Dalle Molle Institute for Artificial Intelligence (IDSIA).

   Description: 3.9M EUR total grant in the FP6 FET Open programme. Consortium of 5 partners. The project focused on the design, implementation, and distributed control of a novel swarm robotic system comprising heterogeneous, dynamically connected small autonomous robots in 3D: eye-bots (flying), hand-bots (grasping), and foot-bots (ground).

7. **Project:** ***BISON: Biology-Inspired techniques for Self-Organization in dynamic Networks***.

   Role: *Co-PI* with Luca Gambardella for IDSIA's research activities in the project (Note: I did not contributed to project writing).

   Funding agency: FP5 FET Open programme - Scientific Institutions of the European Community.

   Duration: 3 years, from 5/2003.

   Amount: 400k CHF.

   Affiliation: Dalle Molle Institute for Artificial Intelligence (IDSIA).

   Description: 1.7M EUR total grant funded in the FP5 FET Open programme. Consortium of 5 partners. The project focused on developing bio-inspired approaches for adaptive routing and control in dynamic networks, such as mobile ad hoc and P2P networks.

6.3 Past Individual Project Grants and Fellowship Support

1. **Marie Curie post-doc fellowship for project *Ant and learning agents for adaptive routing and distributed control in communication networks*.**

   Individual research grant of about 100k EUR awarded by the Marie Curie program of the scientific institutions of the European Community.
   Host institution: IRIDIA, Université Libre de Bruxelles, Belgium.
   Duration: 2.5 years, from 11/2001.

2. **Science & Technology in Japan post-doc fellowship for project *Mobile stigmergetic agents for control of network systems*.**

   Individual research grant of about 130k EUR awarded by the scientific institutions of the European Union.
   Host institution: Advanced Telecommunications Research International (ATR), Kyoto, Japan.
   Duration: 2 years, from 2/1999.

3. **Training and Mobility of Researchers (TMR) post-doc fellowship for project *Multi-agent based techniques for distributed adaptive routing*.**

   Individual research grant of about 100k EUR awarded by the Marie Curie program of the scientific institutions of the European Community.
   Host institution: Université Libre de Bruxelles, Belgium (Note: the grant was not exploited since at the same time I obtained the S&T Fellowship for Japan, which I opted for).
   Duration: 2.5 years, from 2/1999.

4. **Training and Mobility of Researchers (TMR) post-grad fellowship for project *Autonomous reinforcement learning agents for Partially Observable Markov Decision environments*.**

   Individual research grant of about 100k EUR awarded by the Marie Curie program of the scientific institutions of the European Union.
   Host institution: IRIDIA, Université Libre de Bruxelles, Belgium.
   Duration: 2.5 years, from 8/1996.

5. **Post-grad fellowship for studies on *Artificial Intelligence and Robotics*.**

   Individual research grant of about 21k EUR awarded by the municipality of Trento (Italy).
   Host institution: Istituto per la Ricerca Scientifica e Tecnologica (IRST), Trento, Italy.
   Duration: 1 year, from 1/1994.

6. **Post-grad fellowship for studies on *Pattern Recognition*.**

   Individual research grant 11k EUR awarded by the municipality of Trento (Italy).
   Host institution: Istituto per la Ricerca Scientifica e Tecnologica (IRST), Trento, Italy.
   Duration: 0.5 years, from 7/1993.

7 Evidence of Teaching Performance

7.1 Courses Taught at Carnegie Mellon

1. **15-781 Artificial Intelligence: Representation and Problem Solving**
   - Fall'16, in Pittsburgh, 9 units
   - Class of 15 students
   - Average of overall teaching evaluation: 4.57/5
   - Average of overall quality of course evaluation: 4.43/5
2. **15-381 Artificial Intelligence: Representation and Problem Solving**
   - Spring'17, in Doha, 9 units
   - Class of 5 students
   - Average of overall teaching evaluation: 3/5
   - Average of overall quality of course evaluation: 2.67/5
3. **15-381 Artificial Intelligence: Representation and Problem Solving**
   - Fall'17, in Doha, 9 units
   - Class of 2 students
   - Average of overall teaching evaluation: 5/5
   - Average of overall quality of course evaluation: 5/5
4. **16-311 Introduction to Robotics**
   - Fall'17, in Doha, 12 units
   - Class of 2 students
   - Average of overall teaching evaluation: Not submitted
   - Average of overall quality of course evaluation: Not submitted
5. **15-382 Collective Intelligence**
   - Spring'18 in Doha, 9 units
   - Class of 4 students
   - Average of overall teaching evaluation: Not available yet
   - Average of overall quality of course evaluation: Not available yet

7.2 Courses Planned for Next Semester at Carnegie Mellon

1. **16-311 Introduction to Robotics**
   - Fall'18, in Doha, 12 units
2. **16-401 Machine Learning**
   - Fall'18, in Doha, 12 units

7.3 Courses Taught Outside Carnegie Mellon

1. **Robotics**
   - Institution: *University of Lugano (USI), Switzerland*
   - School: Master in Informatics, Department of Informatics
   - When: Spring'16, Spring'15, Spring'14
   - Classes: From 5 to of 25 students
   - Average of course evaluation: 4/5

2. **Operations Research**
   - Institution: *University of Applied Science of Southern Switzerland (SUPSI)*
   - School: Management Engineering
   - When: Fall'15, Fall'14, Fall'13, Fall'12
   - Classes: From 12 to of 24 students
   - Average of course evaluation: 4/5 (Awarded as one of the best SUPSI teachers in Fall'13)

3. **Lab of Algorithms and Data Structures**
   - Institution: *University of Applied Science of Southern Switzerland (SUPSI)*
   - School: Computer Engineering
   - When: Fall'14
   - Classe: 28 students
   - Average of course evaluation: 4.1/5

4. **Heuristic & Heuristics Lab**
   - Institution: *University of Lugano (USI), Switzerland*
   - School: Master in Intelligent Systems, Department of Informatics
   - When: Fall'08, Fall'09, Fall'10, Fall'11, Fall'12
   - Classes: From 5 to of 20 students
   - Average of course evaluation: 3.85/5

5. **Optimization and Process Evaluation**
   - Institution: *University of Applied Science of Southern Switzerland (SUPSI)*
   - School: Management Engineering
   - When: Spring'08
   - Class: 8 students
   - Average of course evaluation: Not available

7.4 Short Courses and Conference Tutorials

1. ***Ant Colony Optimization: theory and hands-on*** (Master of Science in Informatics) - Short course, *Bicocca University*, Milan, Italy, 2013, 8 hours.

2. ***Swarm and collective intelligence*** (Master of Science in Intelligent Systems) - Short course, *University of of Lugano (USI)*, Lugano, Switzerland, from 2007 to 2013, 8 hours.

3. ***Ant Colony Optimization and its application to routing in telecommunication networks*** (Conference Tutorial) - *"ANTS'06, 5th International Workshop on Ant Algorithms and Swarm Intelligence*, Brussels, Belgium, September 4–7, 2006, 6 hours.

4. ***Ant Colony Optimization: from innovative research to successful industrial applications*** (Post-grad Summer School) - *"1st Summer School on Aspects of Complexity"*, University of Bologna, Bertinoro, Italy, July 18–28, 2005, 12 hours

5. ***Swarm intelligence, nature's way to system engineering*** (PhD in Informatics) - Department of Electronics, Computer Science and Automation, *University of Girona*, Spain, April 26–27, 2005, 12 hours

6. ***Swarm intelligence and metaheuristics for combinatorial optimization*** (Post-grad course on Spatial Intelligence) - Department of Geoinformatics, *Helsinki University of Technology (TKK)*, Finland, August 30 - September 3, 2004, 12 hours.

7.5 Outreach Courses

1. **Computer Science and Robotics Lab @Winter Institute: Discover computer science**
   - CMU-Q, Doha, Jan 28 - Feb 1, 2018, 10 hours.
   - Description: Introduction course for high school students to learn how to program in Python; application to programming a mobile ground robot: safely navigate through a track only using short-range sensors.

2. **Robotics Workshop @MindCraft**
   - CMU-Q, Doha, October 14, 2017, 3+3 hours.
   - Description: How to program a mobile robot in Python; create a simple navigation map; use of visual input for moving through a track.

3. **Computer Science and Robotics Lab @Winter Institute: Discover computer science**
   - CMU-Q, Doha, Jan 29 - Feb 2, 2017, 10 hours.
   - Description: Introduction course for high school students to learn how to program in Python; application to programming a mobile ground robot: safely navigate through a track using a map (built by the students) or short-range sensors.

8 Contributions to Education

8.1 Curriculum Design

1. **New course designed: 15-382 Collective Intelligence**

   - Description: The course is conceived as a sort of *domain extension of 15-381*, passing from single agent to multiple agents, and considering different degrees of design complexity and different modality of interaction of the agents. More specifically, the course is about *modeling and control of systems involving a large number of autonomous components that interact with each other, dynamically adapting to their changing environment as a result of mutual, possibly non-linear, interactions.* The course aims to study under which conditions such complex systems can produce self-organized patterns and behaviors, perform effective information dissemination and decision-making.

   - Learning content: Students learn how to design, study, and implement mathematical and computational models of complex multi-component systems, addressing both prediction and control aspects. The course exposes students to models from a number of different, highly interdisciplinary, domains, including: *continuous-time and discrete-time dynamical systems; lattice models and cellular automata; game theory, classical and evolutionary; social choice; distributed consensus; task allocation; swarm intelligence; network science; pattern formation.* Theory and practice are bridged together by homework assignments, that make the students building, analyzing, and experimenting with the models.

   - Web site (course Spring'18): `https://web2.qatar.cmu.edu/~gdicaro/15382/`

2. **Course (re)designed for Qatar: 16-311 Introduction to Robotics**

   - Motivation: In the Qatar campus (like in other CMU campuses other than Pittsburgh), 16-311 is likely the only course on robotics that could be offered on regular basis. It is therefore appropriate to design the course based on this observation / limitation, aiming to provide a content which is at the same time broad and specialized, since the students won't have many other opportunities to explore further topics related to robotics. In this perspective, I've designed the course to include core foundational aspects of modern robotics, with a focus on *mobile autonomous robotics*, that naturally requires to address a number of scientific challenges and features a wide range of interesting application scenarios. Moreover, since robotics really needs to put theory into practice, and nowadays robotics, both in the academia and in the industry, means using ROS (Robot Operating System), I made the choice to let the students learning this tool essential for effective robot programming and interaction, both in simulation and in real robots.

   - Description: Course topics includes: *forward and inverse kinematics modeling; proprio- and exteroceptive sensing; localization, mapping, SLAM; navigation; motion planning; task allocation in multi-robot systems.* I also made an effort to expose the students to topics that are important per se, beyond robotics, and that they would hardly get in touch with here in Qatar, such as *open-loop and feedback-based control, parametric (Extended Kalman Filters) and non-parametric (Bayesian filters) techniques for state estimation.* For practicing, the students use ground mobile robots, the *TurtleBot2*, programmed using *ROS*, while simulation studies are performed using the *ROS/Gazebo* simulator.

   - Learning content: Acquisition of core knowledge, both theoretical and practical, for the modeling, programming, and control of autonomous mobile robots and multi-robot systems; familiarity with the fundamental challenges and potentialities of autonomous and industrial robotic applications; working knowledge of ROS and Gazebo for both real and simulated robots.

   - Web site (course Fall'17): `https://web2.qatar.cmu.edu/~gdicaro/16311/`

8.2 Lecture Notes and Course Materials

1. **16-311 Introduction to robotics: ROS tutorial**

   - Motivation: Teaching a class how to use *ROS for programming and interfacing with the robot* (both in simulation and with real robots) is not, usually, an easy task. The learning curve is steep, and students typically struggle. Many ROS tutorial are available from the Internet, however, none of them is really providing a comprehensive, coherent, consistent, and quick path from zero to start practicing the complex concepts of a robotics course.

   - Contribution: Original preparation of a *35-pages hands-on tutorial on ROS:* from scratch to being fully operational in 10 days using ROS/Gazebo in simulation and the TurtleBot 2 robot (including its on-board sensors and actuators, such as depth camera, 2D laser scan, etc.). By attending to one single introductory lecture on general ROS concepts, and the tutorial to go through as first homework, all students were able to seamlessly implement and deploy their first reactive ROS navigation package in 10-days time. From there, they have been able to build way more complex ROS-based controllers. I plan to keep adapting and expanding the tutorial to fully cover the needs of 16-311, and, more in general, of an introductory undergraduate course in robotics, to possibly make an *open-source textbook.*

   - Full text: Accessible in course website, `https://web2.qatar.cmu.edu/~gdicaro/16311/slides/start-with-ros.pdf`

9 Student Advising

9.1 Completed Ph.D. Students

1. Eduardo Feo-Flushing
   - **Cooperative missions with heterogeneous networked teams**, Dec. 2017
   - Institution: *University of Lugano (USI), Switzerland*
   - Co-advisor: Prof. Luca Gambardella
   - Employed at IDSIA, Switzerland

2. Jawad Nagi
   - **Human-swarm symbiotic interaction**, Aug. 2016
   - Institution: *University of Lugano (USI), Switzerland*
   - Co-advisor: Prof. Luca Gambardella
   - Moving from NYC to a Swiss ICT company

9.2 Undergraduate Senior Thesis and Research Projects

1. **Senior Thesis, Co-Advisor:** School of Computer Science, CMU-Q, Doha. Academic year 2017-18. Subject: *Deep learning and pattern analysis for crack detection.* **Best Project Award at the Meeting of the Minds 2018, CMU-Q**. Student: Fatma Tlili.

2. **Senior Thesis, Advisor:** School of Computer Science, CMU-Q, Doha. Academic year 2017-18. Subject: *A mixed initiative system for survivable path planning in unknown cluttered environments* **Best CS Project Award from Qatar National Research Fund (QNRF) at the Meeting of the Minds 2018**, CMU-Q. Student: Rohith Pillai.

3. **Senior Thesis, Co-Advisor:** School of Computer Science, CMU-Q, Doha. Academic year 2017-18. Subject: *A learning approach to vision-based coarse localization in industry*, Student: Aisha Mohamed.

4. **QSIURP project, Advisor:** Computer Science, CMU-Q, Doha. Summer 2017. Subject: *A distributed approach to multi-robot collision-free vehicle routing in dynamic environments.* Students: Zan Naeem, Mohamed Zakzok.

5. **Independent Study, Co-Advisor:** School of Computer Science, CMU-Q, Doha. Spring semester 2017. Subject: *Developing modern Web applications with best practices.* Student: Yasser Mahmoud Elsayed.

6. **BSc. Thesis in Management Engineering, Co-Advisor:** *Models and algorithms for lot-sizing problems*, 2009. Institution: University of Applied Science of Southern Switzerland, Lugano, Switzerland. Student: Franjo Majstorovic.

7. **Research Internship in Networking, 6 months, Advisor:** *Adaptive routing in networks on-chip*, 2005. Workplace: IDSIA. Student: Neha Bhargava.

8. **BEng. thesis in Electronics Engineering, Co-Advisor:** *Adaptive load balancing in telecommunications networks*, 1998. Institution: Politecnico of Milano, Italy. Workplace: IRIDIA, Belgium. Student: Emanuele Persico.

9.3 M.S. Thesis or M.S. / Ph.D. Research Projects

1. **Student Internship in Robotics, Advisor:** *Decentralized position control of data collectors for multicenter data storage in mobile robotic networks*, 6 months, 2016. Funding Institution: NCCR Robotics, Switzerland. Workplace: IDSIA. Student: Kaviya Dhanabalachandran.

2. **Ph.D. in Informatics, Research Advisor:** *Multi-modal human multi-robot interaction*, starting in 2015, running. Institution: University of Lugano, Switzerland. Work in context of the NCCR Robotics project "Symbiotic interaction between humans and multi-robot systems" (funded by Swiss NSF). Ph.D. student: Boris Gromov.

3. **Research Internship in Mobile Networking, Advisor:** *Dynamic node placement in robotic MANETs*, 4 months, 2014. Funding Institution: University of Granada, Spain. Workplace: IDSIA. Ph.D. Student: Roberto Magán Carrión. Current occupation: Post-doc researcher at Granada University, Spain.

4. **Research Internship in Robotics, Advisor:** *Cooperative monitoring of disaster areas with UAVs teams*, 6 months, 2014. Funding Institution: NCCR Robotics, Switzerland. Workplace: IDSIA. Researcher: Fatemeh Mohseni. Current occupation: Ph.D. student at Linköping University, Sweden.

5. **MSc. thesis in Computer Engineering, Co-Advisor:** *Multi-robot fair target tracking with uncertain observations and mobility prediction*, 2013. Institution: Politecnico of Milan, Italy. Workplace: IDSIA. Student: Jacopo Banfi. Current occupation: Ph.D. student at Politecnico of Milan, Italy.

6. **Ph.D. in Informatics, Research Advisor:** *Resilient path planning for multi-robot systems*, started in 2013, running. Institution: University of Lugano, Switzerland. Work in context of the NCCR Robotics project "Resilient path planning for ground robots" (funded by Swiss NSF). Ph.D. student: Jérôme Guzzi.

7. **MSc. thesis in Informatics, Advisor:** *A cooperative distributed protocol for link quality learning in wireless networks*, 2012. Institution: University of Lugano, Switzerland. Student: Imran Ahmed.

8. **MSc. thesis in Informatics, Advisor:** *Optimal relay node placement for throughput enhancement in wireless sensor networks*, 2010. Institution: joint programme of the Universities of Trento and Aachen. Workplace: IDSIA. Student: Eduardo Feo.

9. **MSc. thesis in Computer Science Engineering, Co-Advisor:** *Swarms of flying robots performing distributed path planning for objects on the ground*, 2010. Institution: Politecnico of Milano, Italy. Workplace: IDSIA. Student: Andreagiovanni Reina. Current occupation: Post-doc researcher at Sheffield University, UK.

10. **MSc. thesis in Bioinformatics, Co-Advisor:** *A computational model for the immune system and its aging*, 1999. Institution: Dept. of Biology, Manchester University, UK. Student: Silvana Valensin.

11. **MSc. thesis in Physics, Co-Advisor:** *Study of the diversity of antibodies using genetic algorithms*, 1994. Institution: University of Bologna, Italy. Student: Silvana Valensin.

9.4 Ph.D. Thesis Committee Service

1. Pedro Veloso
   - *School of Architecture, CMU, Pittsburgh*
   - **designLOOP: A multi-agent system for architectural composition**
   - Started in 12/2016, admitted to dissertation phase in Dec. 2017
   - Advisor: Prof. Ramesh Krishnamurti

2. Zhiang Zhang
   - *School of Architecture, CMU, Pittsburgh*
   - **Building energy model based optimal control of HVAC Systems: a deep reinforcement learning approach**
   - Started in 12/2016, admitted to the dissertation phase in May 2018
   - Advisor: Prof. Khee Poh Lam

9.5 External Examiner for M.S. or Ph.D. Thesis

- Ph.D. thesis, Angelo Trotta: *Next-generation public safety systems based on autonomous vehicles and opportunistic communications*, Università di Bologna, Computer Science and Eng., Italy, April, 2017

- Ph.D. thesis, Milan Erdelj: *Mobile wireless sensor network architecture: Applications to mobile sensor deployment*, Université des Sciences et Technologies de Lille, INRIA Lille, France, Octobre 11, 2013

- M.Sc. thesis, Giuseppe Cuccu: *Variable Size Populations for Dynamic Optimization with Genetic Programming*, Computer Science Department, Università Bicocca, Milan, Italy, February 2008

- Ph.D. thesis, Samih Tadrus: *Generic Multi-Pheromone Quality of Service Routing*, School of Computer Science, University of Nottingham, England, July 2007

- Ph.D. thesis, Luc Hogie: *Delay Tolerant Networks: Modelling, Simulation and Broadcast-based Applications*, Computer Science institute, University of Luxembourg, April 2007