PROGRAMMA DEL CORSO DI DOTTORATO

Modeling and simulation of emerging collective behavior

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Periodo: marzo-aprile 2015
3 moduli da 8 ore ciascuno, 2 lezioni a settimana, 2 settimane per ogni modulo

Si tratta di un tema abbastanza recente su cui c'è molta attività negli ultimi anni. Il corso dovrebbe presenterà vari approcci modellistici tra cui i modelli cinetici e micro/macro, e la loro approssimazione numerica.

Per la sua natura, il corso puo' coinvolgere studenti interessati alla modellistica, alle equazioni alle derivate parziali e all'analisi numerica.

PRIMO MODULO (A. TOSIN)
Macroscopic and kinetic models of vehicular traffic flows

1. Introduction to microscopic and macroscopic traffic models
2. Macroscopic models and conservation laws: construction of solutions
3. Discrete-state kinetic models and stochastic games
4. Kinetic models on networks

Bibliografia

B. Piccoli, A. Tosin, Vehicular traffic: A review of continuum mathematical models In R. A. Meyers, Ed., Encyclopedia of Complexity and Systems Science vol. 22, pp. 9727-9749, Springer, New York, 2009
2. L. Fermo, A. Tosin, A fully-discrete-state kinetic theory approach to modeling vehicular traffic, SIAM J. Appl. Math., 73(4):1533-1556, 2013
3. L. Fermo, A. Tosin, A fully-discrete-state kinetic theory approach to traffic flow on road networks, Math. Models Methods Appl. Sci., 2015 (to appear)

SECONDO MODULO (L. PARESCHI)
Kinetic description of collective dynamics in socio-economic and biological systems

1. Multi-agent kinetic equations and simulation methods
2. Socio-economic modeling and financial markets
3. Consensus, flocking and swarming dynamics
4. Mean field control and uncertainty quantification

Bibliografia
1. L. Pareschi, G. Toscani, Interacting Multiagent Systems:Kinetic equations and Monte Carlo methods, Oxford University Press, (2013).
2. G. Naldi, L. Pareschi, G. Toscani (Eds), Mathematical Modeling of Collective

Behavior in Socio-Economic and Life Sciences, Birkhäuser Boston (2010).

TERZO MODULO (E. CRiSTIANI)
Multiscale models for simulating and controlling pedestrian flows

1. Microscopic and macroscopic models for pedestrian dynamics.
2. Multiscale models for pedestrian dynamics.
3. Numerical approximation of 2D conservation laws.
4. Control of pedestrian dynamics.

Bibliografia
1. Cristiani, E., Piccoli, B., Tosin, A., Multiscale modeling of pedestrian dynamics, Springer, 2014.
2. Cristiani, E., Piccoli, B., Tosin, A., Multiscale modeling of granular flows with application to crowd dynamics, Multiscale Model. Simul. 9, 155–182 (2011).
3. Cristiani, E., Priuli, F.S., Tosin, A., Modeling rationality to control self-organization of crowds: an environmental approach, arXiv:1406.7246
4. Bellomo, N., Dogbé, C., On the modeling of traffic and crowds: a survey of models, speculations, and perspectives, SIAM Rev. 53, 409–463 (2011).
5. Lachapelle, A., Wolfram, M.T., On a mean field game approach modeling congestion and aversion in pedestrian crowds, Transp. Res. B 45, 1572–1589 (2011).
6. LeVeque, R. J., Numerical methods for conservation laws, Birkhauser, 1992.