Publications of LISC related to Viability Theory

Viability of specific systems or connecting viability and other domains

- S. Martin, I. Alvarez, J.D. Kant, **Micro/macro viability analysis of individual-based models: Investigation into the viability of a stylized agricultural cooperative**, 2014
- C. Rougé, J.D. Mathias, G. Deffuant, **Relevance of control theory to design and maintenance problems in time-variant reliability: The case of stochastic viability**, 2014
- W. Wei, S. Martin, I. Alvarez, **Sustainability analysis: Viability concepts to consider transient and asymptotical dynamics in socio-ecological tourism-based systems**, 2013
- C. Bernard, S. Martin, **Comparing the sustainability of different action policy possibilities: Application to the issue of both household survival and forest preservation in the corridor of Fianarantsoa**, 2013
- N. Sicard, N. Perrot, R. Reuillon, S. Mesmoudi, I. Alvarez, S. Martin, **A viability approach to control food processes: Application to a Camembert cheese ripening process**, 2012
- C. Bernard, S. Martin, **Building strategies to ensure langage coexistence in presence of bilingualism**, 2012
- L. Chapel, G. Deffuant, S. Martin, C. Mullon, **Defining yield policies in a viability approach**, 2008

Defining resilience within Viability Theory

The original idea of defining resilience within the framework of viability theory comes from Martin (2004). Since then, many works of LISC researchers have further developed this area of research.

- C. Rougé, J.D. Mathias, G. Deffuant
  Extending the viability theory framework of resilience to uncertain dynamics, and application to lake eutrophication
  Ecological Indicators 29, 2013 abs pdf doi bib Resilience, the capacity for a system to recover from a perturbation so as to keep its properties and functions, is of growing concern to a wide range of environmental systems. The challenge is often to render this concept operational without betraying it, nor diluting its content. The focus here is on building on the viability theory framework of resilience to extend it to discrete-time stochastic dynamical systems. The viability framework describes properties of the system as a subset of its state space. This property is resilient to a perturbation if it can be recovered and kept by the system after a perturbation: its trajectory can come back and stay in the subset. This is shown to reflect a general definition of resilience. With stochastic dynamics, the stochastic viability kernel describes the robust states, in which the system has a high probability of staying in the subset for a long time. Then, probability of resilience is defined as the maximal probability that the system reaches a robust state within a time horizon. Management strategies that maximize the probability of resilience can be found through dynamic programming. It is then possible to compute a range of statistics on the time for restoring the property. The approach is illustrated on the example of lake eutrophication and shown to foster the

use of different indicators that are adapted to distinct situations. Its relevance for the management of ecological systems is also discussed.close @article{PUB00037792, author = {Rougé, C. and Mathias, J.D. and Deffuant, G.}, title = {Extending the viability theory framework of resilience to uncertain dynamics, and application to lake eutrophication}, title = {Extension du cadre viabiliste de la résilience à des dynamiques incertaines et application à l'eutrophisation d'un lac}, journal = {Ecological Indicators}, volume = {29}, pages = {420-433}, pdf = {http://motive.cemagref.fr/_publication/PUB00037792.pdf}, doi = {http://dx.doi.org/10.1016/j.ecolind.2012.12.032}, year = {2013}, affiliation = {IRSTEA CLERMONT FERRAND UR LISC FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA}, abstract = {Resilience, the capacity for a system to recover from a perturbation so as to keep its properties and functions, is of growing concern to a wide range of environmental systems. The challenge is often to render this concept operational without betraying it, nor diluting its content. The focus here is on building on the viability theory framework of resilience to extend it to discrete-time stochastic dynamical systems. The viability framework describes properties of the system as a subset of its state space. This property is resilient to a perturbation if it can be recovered and kept by the system after a perturbation: its trajectory can come back and stay in the subset. This is shown to reflect a general definition of resilience. With stochastic dynamics, the stochastic viability kernel describes the robust states, in which the system has a high probability of staying in the subset for a long time. Then, probability of resilience is defined as the maximal probability that the system reaches a robust state within a time horizon. Management strategies that maximize the probability of resilience can be found through dynamic programming. It is then possible to compute a range of statistics on the time for restoring the property. The approach is illustrated on the example of lake eutrophication and shown to foster the use of different indicators that are adapted to distinct situations. Its relevance for the management of ecological systems is also discussed.},}
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- S. Martin, G. Deffuant, J.M. Calabrese
  Defining resilience mathematically: from attractors to viability
  Viability and resilience of complex systems: ; concepts, methods and case studies from ecology and society (p. 15-36), Springer, 2011 doi web bib @book{PUB00033173, author = {Martin, S. and Deffuant, G. and Calabrese, J.M.}, author = {Deffuant, G. and Gilbert, N.}, title = {Defining resilience mathematically: from attractors to viability}, bookTitle = {Viability and resilience of complex systems: ; concepts, methods and case studies from ecology and society}, series = {Understanding complex systems}, publisher = {Springer}, pages = {15-36}, url = {http://cemadoc.irstea.fr/cemoa/PUB00033173}, doi = {http://dx.doi.org/10.1007/978-3-642-20423-4}, year = {2011}, affiliation = {CEMAGREF CLERMONT FERRAND UR LISC FRA ; CEMAGREF CLERMONT FERRAND UR LISC FRA ; UFZ HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH LEIPZIG DEU}, ISBNISSN = {ISBN-13: 978-3642204227}, abstract = {},}
close
- G. Deffuant, N. Gilbert
  Viability and resilience of complex systems: concepts, methods and case studies from ecology and society
  Springer, 2011 abs doi web bib One common characteristic of a complex system is its ability to withstand major disturbances and the capacity to rebuild itself. Understanding how such systems demonstrate resilience by absorbing or recovering from major external perturbations requires both quantitative foundations and a multidisciplinary view of the topic. This book demonstrates how new methods can be used to identify the actions favouring the recovery from perturbations on a variety of examples including the dynamics of bacterial biofilms, grassland savannahs, language competition and Internet social networking sites. The reader is taken through an introduction to

the idea of resilience and viability and shown the mathematical basis of the techniques used to analyse systems. The idea of individual or agent-based modelling of complex systems is introduced and related to analytically tractable approximations of such models. A set of case studies illustrates the use of the techniques in real applications, and the final section describes how one can use new software tools for carrying out the necessary calculations. The book is intended for a general scientific audience of readers from the natural and social sciences, although it requires some mathematics to gain a full understanding of the more theoretical chapters. It is an essential point of reference for those interested in the practical application of the concepts of resilience and viability.close @book{PUB00033170, author = {Deffuant, G. and Gilbert, N.}, title = {Viability and resilience of complex systems: concepts, methods and case studies from ecology and society}, series = {Understanding complex systems}, publisher = {Springer}, pages = {233}, url = {http://cemadoc.irstea.fr/cemoa/PUB00033170}, doi = {http://dx.doi.org/10.1007/978-3-642-20423-4}, year = {2011}, affiliation = {CEMAGREF CLERMONT FERRAND UR LISC FRA ; UNIVERSITY OF SURREY CENTRE FOR RESEARCH IN SOCIAL SIMULATION GUILFORD GBR}, ISBNISSN = {ISBN-13: 978-3642204227}, abstract = {One common characteristic of a complex system is its ability to withstand major disturbances and the capacity to rebuild itself. Understanding how such systems demonstrate resilience by absorbing or recovering from major external perturbations requires both quantitative foundations and a multidisciplinary view of the topic. This book demonstrates how new methods can be used to identify the actions favouring the recovery from perturbations on a variety of examples including the dynamics of bacterial biofilms, grassland savannahs, language competition and Internet social networking sites. The reader is taken through an introduction to the idea of resilience and viability and shown the mathematical basis of the techniques used to analyse systems. The idea of individual or agent-based modelling of complex systems is introduced and related to analytically tractable approximations of such models. A set of case studies illustrates the use of the techniques in real applications, and the final section describes how one can use new software tools for carrying out the necessary calculations. The book is intended for a general scientific audience of readers from the natural and social sciences, although it requires some mathematics to gain a full understanding of the more theoretical chapters. It is an essential point of reference for those interested in the practical application of the concepts of resilience and viability.},}
close

- L. Chapel, X. Castello, C. Bernard, G. Deffuant, V. Eguiluz, S. Martin, M. San Miguel
  Viability and resilience of languages in competition
  PLoS One 5 (1 (e8681)), 2010 abs pdf doi web bib We study the viability and resilience of languages, using a simple dynamical model of two languages in competition. Assuming that public action can modify the prestige of a language in order to avoid language extinction, we analyze two cases: (i) the prestige can only take two values, (ii) it can take any value but its change at each time step is bounded. In both cases, we determine the viability kernel, that is, the set of states for which there exists an action policy maintaining the coexistence of the two languages, and we define such policies. We also study the resilience of the languages and identify configurations from where the system can return to the viability kernel (definite resilience), or where one of the languages is lead to disappear (zero resilience). Within our current framework, the maintenance of a bilingual society is shown to be possible by introducing the prestige of a language as a control variable.close @article{PUB00027990, author = {Chapel, L. and Castello, X. and Bernard, C. and Deffuant, G. and Eguiluz, V. and Martin, S. and San Miguel, M.}, title = {Viability and resilience of languages in competition}, title = {Viabilité et résilience de langues en compétitions}, journal = {PLoS One}, volume = {5}, number = {1 (e8681)}, pages = {11}, pdf = {http://motive.cemagref.fr/_publication/PUB00027990.pdf}, url = {http://www.plosone.org/article/info:doi/10.1371/journal.pone.0008681}, cemadoc = {http://cemadoc.irstea.fr/cemoa/PUB00027990}, doi =

{http://dx.doi.org/10.1371/journal.pone.0008681}, year = {2010}, affiliation = {CEMAGREF CLERMONT FERRAND UR LISC FRA ; IFISC ESP ; CEMAGREF CLERMONT FERRAND UR LISC FRA ; CEMAGREF CLERMONT FERRAND UR LISC FRA ; IFISC ESP ; CEMAGREF CLERMONT FERRAND UR LISC FRA ; IFISC ESP}, abstract = {We study the viability and resilience of languages, using a simple dynamical model of two languages in competition. Assuming that public action can modify the prestige of a language in order to avoid language extinction, we analyze two cases: (i) the prestige can only take two values, (ii) it can take any value but its change at each time step is bounded. In both cases, we determine the viability kernel, that is, the set of states for which there exists an action policy maintaining the coexistence of the two languages, and we define such policies. We also study the resilience of the languages and identify configurations from where the system can return to the viability kernel (definite resilience), or where one of the languages is lead to disappear (zero resilience). Within our current framework, the maintenance of a bilingual society is shown to be possible by introducing the prestige of a language as a control variable.},}
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- S. Martin
  The cost of restoration as a way of defining resilience: a viability approach applied to a model of lake eutrophication
  Ecology and Society 9 (2), 2004 abs web bib Multiple stable states or alternative equilibria in ecological systems have been recognized since the 1960s in the ecological literature. Very often, the shift between alternative states occurs suddenly and the resource flows from these systems are modified. Resilience is the capacity of a system to undergo disturbance and maintain its functions and controls. It has multiple levels of meaning, from the metaphorical to the specific. However, most studies that explore resilience-related ideas have used resilience as a metaphor or theoretical construct. In a few cases, it has been defined operationally in the context of a model of a particular system. In this paper, resilience is defined consistently with the theoretical uses of the term, in the context of ecosystem models within an application to a simple model of lake eutrophication. The theoretical definitions of resilience and the characteristics of the operational definition that are necessary for ensuring consistency are reviewed. A mathematical formulation of resilience is built in the framework of the viability theory. This formulation emphasizes the link between resilience and the cost of the recovery after a disturbance. This cost is first chosen in relation to the time of crisis in the application to a model of lake eutrophication. The resilience values are then obtained by numerical integration. For another choice of the cost function, the viability algorithm is needed to compute the resilience values. These applications demonstrate the usefulness of our operational definition.close @article{PUB00015017, author = {Martin, S.}, title = {The cost of restoration as a way of defining resilience: a viability approach applied to a model of lake eutrophication}, journal = {Ecology and Society}, volume = {9}, number = {2}, pages = {19}, url = {http://www.ecologyandsociety.org/vol9/iss2/art8}, cemadoc = {http://cemadoc.irstea.fr/cemoa/PUB00015017}, year = {2004}, affiliation = {CEMAGREF CLERMONT FERRAND LISC}, number = {K LI04 4}, abstract = {Multiple stable states or alternative equilibria in ecological systems have been recognized since the 1960s in the ecological literature. Very often, the shift between alternative states occurs suddenly and the resource flows from these systems are modified. Resilience is the capacity of a system to undergo disturbance and maintain its functions and controls. It has multiple levels of meaning, from the metaphorical to the specific. However, most studies that explore resilience-related ideas have used resilience as a metaphor or theoretical construct. In a few cases, it has been defined operationally in the context of a model of a particular system. In this paper, resilience is defined consistently with the theoretical uses of the term, in the context of ecosystem models within an application to a simple model of lake eutrophication. The theoretical definitions of resilience and the characteristics of the operational definition that are necessary for ensuring consistency are reviewed. A mathematical

formulation of resilience is built in the framework of the viability theory. This formulation emphasizes the link between resilience and the cost of the recovery after a disturbance. This cost is first chosen in relation to the time of crisis in the application to a model of lake eutrophication. The resilience values are then obtained by numerical integration. For another choice of the cost function, the viability algorithm is needed to compute the resilience values. These applications demonstrate the usefulness of our operational definition.},}
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Defining robustness within viability Theory

- S. Mesmoudi, I. Alvarez, S. Martin, R. Reuillon, M. Sicard, N. Perrot
  Coupling geometric analysis and viability theory for system exploration: Application to a living food system
  Journal of Process Control 24 (12), 2014 abs pdf doi web bib This paper addresses the issue of studying a food complex system in a reverse engineering manner with the aim of identifying the set of all possible actions that makes it reach a quality target with respect to manufacturing constraints. Once the set of actions is identified, several criteria can be considered to identify interesting trajectories and control policies. A viability approach, coupling the viability theory and a geometric approach of robustness, is proposed to study complex dynamical systems. It can be implemented for several types of systems, from linear to non linear or hybrid systems. The proposed framework was adapted to a living food system: a ripening model of Camembert cheese to identify the set of states and actions (capture basin) from which it is possible to reach a predefined quality target. Within the set of viable trajectories, particular trajectories that improve the Camembert cheese ripening process are identified using the proposed approach. The results are applied at a pilot scale and are discussed in this paper.close @article{PUB00043300, author = {Mesmoudi, S. and Alvarez, I. and Martin, S. and Reuillon, R. and Sicard, M. and Perrot, N.}, title = {Coupling geometric analysis and viability theory for system exploration: Application to a living food system}, title = {Coupler l'analyse géométrique et la théorie de la viabilité pour explorer les dynamiques des systèmes : application à un système alimentaire}, journal = {Journal of Process Control}, volume = {24}, number = {12}, pages = {18-28}, pdf = {http://motive.cemagref.fr/_publication/PUB00043300.pdf}, url = {http://www.sciencedirect.com/science/article/pii/S0959152414002522}, cemadoc = {http://cemadoc.irstea.fr/cemoa/PUB00043300}, doi = {http://dx.doi.org/10.1016/j.jprocont.2014.09.013}, year = {2014}, affiliation = {ISCPIF LIP6 PARIS FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA ; ISCPIF PARIS FRA ; INRA UMR 782 GMPA AGROPARISTECH THIVERVAL GRIGNON FRA ; INRA UMR 782 GMPA AGROPARISTECH THIVERVAL GRIGNON FRA}, abstract = {This paper addresses the issue of studying a food complex system in a reverse engineering manner with the aim of identifying the set of all possible actions that makes it reach a quality target with respect to manufacturing constraints. Once the set of actions is identified, several criteria can be considered to identify interesting trajectories and control policies. A viability approach, coupling the viability theory and a geometric approach of robustness, is proposed to study complex dynamical systems. It can be implemented for several types of systems, from linear to non linear or hybrid systems. The proposed framework was adapted to a living food system: a ripening model of Camembert cheese to identify the set of states and actions (capture basin) from which it is possible to reach a predefined quality target. Within the set of viable trajectories, particular trajectories that improve the Camembert cheese ripening process are identified using the proposed approach. The results are applied at a pilot scale and are discussed in this paper.},}
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- I. Alvarez, S. Martin
  Geometric robustness of viability kernels and resilience basins
  Viability and resilience of complex systems: concepts, methods and case studies from ecology and society (p. 193-218), Springer, 2011 doi web bib @book{PUB00033189, author = {Alvarez, I. and Martin, S.}, author = {Deffuant, G. and Gilbert, N.}, title = {Geometric robustness of viability kernels and resilience basins}, bookTitle = {Viability and resilience of complex systems: concepts, methods and case studies from ecology and society}, series = {Understanding complex systems}, publisher = {Springer}, pages = {193-218}, url = {http://cemadoc.irstea.fr/cemoa/PUB00033189}, doi = {http://dx.doi.org/10.1007/978-3-642-20423-4}, year = {2011}, affiliation = {CEMAGREF CLERMONT FERRAND UR LISC FRA ; CEMAGREF CLERMONT FERRAND UR LISC FRA}, ISBNISSN = {ISBN-13: 978-3642204227}, abstract = {}, }
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Defining vulnerability

- J.B. Rouquier, I. Alvarez, R. Reuillon, P.H. Wuillemin
  A kd-tree algorithm to discover the boundary of a black box hypervolume
  Annals of Mathematics and Artificial Intelligence 75 (3), 2015 abs doi web bib n the framework of Decision Support Systems, mathematical viability theory can be used to classify the states and the trajectories of a dynamical system evolving in a set of desirable states. Since obtaining this viability theory output is a complex and computationally intensive task, we propose in this article to consider a compact representation of this set and its approximations using kd-trees. Given a subset of R^n of non null measure, defined through a black box function (an oracle), and assuming some regularity properties on this set, we build a kd-tree based data structure representing this set, which can be used as an input to the viability algorithm. This data structure has a complexity close to gaining one dimension, both in terms of space and in number of calls to the oracle, compared to the exhaustive computation on a regular grid. This data structure produces a characteristic function (i.e. a function that can be used in lieu of the oracle), allows to measure the volume of the set, and to compute the distance to the boundary of the set for any point. It offers distance guarantee between the points of the original set and its kd-tree approximation.close @article{PUB00046791, author = {Rouquier, J.B. and Alvarez, I. and Reuillon, R. and Wuillemin, P.H.}, title = {A kd-tree algorithm to discover the boundary of a black box hypervolume}, title = {Un algorithme basé sur les kd-tree pour découvrir la frontière d'un hypervolume boîte-noire}, journal = {Annals of Mathematics and Artificial Intelligence}, volume = {75}, number = {3}, pages = {335-350}, url = {http://cemadoc.irstea.fr/cemoa/PUB00046791}, doi = {http://dx.doi.org/10.1007/s10472-015-9456-8}, year = {2015}, affiliation = {INSTITUT DES SYSTEMES COMPLEXES PARIS FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA ; INSTITUT DES SYSTEMES COMPLEXES PARIS FRA ; UNIVERSITE DE PARIS VI UMR 7606 LIP6 LABORATOIRE D'INFORMATIQUE DE PARIS FRA}, abstract = {n the framework of Decision Support Systems, mathematical viability theory can be used to classify the states and the trajectories of a dynamical system evolving in a set of desirable states. Since obtaining this viability theory output is a complex and computationally intensive task, we propose in this article to consider a compact representation of this set and its approximations using kd-trees. Given a subset of R^n of non null measure, defined through a black box function (an oracle), and assuming some regularity properties on this set, we build a kd-tree based data structure representing this set, which can be used as an input to the viability algorithm. This data structure has a complexity close to gaining one dimension, both in terms of space and in number of calls to

the oracle, compared to the exhaustive computation on a regular grid. This data structure produces a characteristic function (i.e. a function that can be used in lieu of the oracle), allows to measure the volume of the set, and to compute the distance to the boundary of the set for any point. It offers distance guarantee between the points of the original set and its kd-tree approximation.},}

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- C. Rougé, J.D. Mathias, G. Deffuant
  Vulnerability: from the conceptual to the operational using a dynamical system perspective
  Environmental Modelling & Software 73, 2015 doi web bib @article{PUB00045375, author = {Rougé, C. and Mathias, J.D. and Deffuant, G.}, title = {Vulnerability: from the conceptual to the operational using a dynamical system perspective}, journal = {Environmental Modelling & Software}, volume = {73}, pages = {218-230}, url = {http://cemadoc.irstea.fr/cemoa/PUB00045375}, doi = {http://dx.doi.org/10.1016/j.envsoft.2015.07.018}, year = {2015}, affiliation = {IRSTEA CLERMONT FERRAND UR LISC FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA}, abstract = {},}

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Computational issues

- A. Brias, J.D. Mathias, G. Deffuant
  Accelerating viability kernel computation with CUDA architecture: application to bycatch fishery management
  Computational Management Science 13 (3), 2016 abs doi web bib Computing a viability kernel consumes time and memory resources which increase exponentially with the dimension of the problem. This curse of dimensionality strongly limits the applicability of this approach, otherwise promising. We report here an attempt to tackle this problem with Graphics Processing Units (GPU). We design and implement a version of the viability kernel algorithm suitable for General Purpose GPU (GPGPU) computing using Nvidia's architecture, CUDA (Computing Unified Device Architecture). Different parts of the algorithm are parallelized on the GPU device and we test the algorithm on a dynamical system of theoretical population growth. We study computing time gains as a function of the number of dimensions and the accuracy of the grid covering the state space. The speed factor reaches up to 20 with the GPU version compared to the Central Processing Unit (CPU) version, making the approach more applicable to problems in 4 to 7 dimensions. We use the GPU version of the algorithm to compute viability kernel of bycatch fishery management problems up to 6 dimensions.close @article{PUB00046149, author = {Brias, A. and Mathias, J.D. and Deffuant, G.}, title = {Accelerating viability kernel computation with CUDA architecture: application to bycatch fishery management}, title = {Accélérer le calcul de noyau de viabilité avec l'architecture CUDA : application à la gestion de pêcherie avec prises accessoires}, journal = {Computational Management Science}, volume = {13}, number = {3}, pages = {371-391}, url = {http://cemadoc.irstea.fr/cemoa/PUB00046149}, doi = {http://dx.doi.org/10.1007/s10287-015-0246-x}, year = {2016}, affiliation = {IRSTEA CLERMONT FERRAND UR LISC FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA ; IRSTEA CLERMONT FERRAND UR LISC FRA}, abstract = {Computing a viability kernel consumes time and memory resources which increase exponentially with the dimension of the problem. This curse of dimensionality strongly limits the applicability of this approach, otherwise promising. We report here an attempt to tackle this problem with Graphics Processing Units (GPU). We design and implement a version of the viability kernel algorithm suitable for General Purpose GPU (GPGPU) computing using Nvidia's architecture, CUDA (Computing Unified Device Architecture). Different

parts of the algorithm are parallelized on the GPU device and we test the algorithm on a dynamical system of theoretical population growth. We study computing time gains as a function of the number of dimensions and the accuracy of the grid covering the state space. The speed factor reaches up to 20 with the GPU version compared to the Central Processing Unit (CPU) version, making the approach more applicable to problems in 4 to 7 dimensions. We use the GPU version of the algorithm to compute viability kernel of bycatch fishery management problems up to 6 dimensions.},}
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- G. Deffuant, L. Chapel, S. Martin
  Approximating viability kernels with support vector machines
  IEEE Transactions on Automatic Control 52 (5), 2007 abs pdf bib We propose an algorithm which performs a progressive approximation of a viability kernel, iteratively using a classification method. We establish the mathematical conditions that the classification method should fulfill to guarantee the convergence to the actual viability kernel. We study more particularly the use of support vector machines (SVMs) as classification techniques. We show that they make possible to use gradient optimisation techniques to find a viable control at each time step, and over several time steps. This allows us to avoid the exponential growth of the computing time with the dimension of the control space. It also provides simple and efficient control procedures. We illustrate the method with some examples inspired from ecology. close @article{PUB00036305, author = {Deffuant, G. and Chapel, L. and Martin, S.}, title = {Approximating viability kernels with support vector machines}, title = {Approcher des noyaux de viabilité avec des machines à vecteurs supports}, journal = {IEEE Transactions on Automatic Control}, volume = {52}, number = {5}, pages = {933-937}, pdf = {http://motive.cemagref.fr/_publication/PUB00036305.pdf}, year = {2007}, affiliation = {CEMAGREF CLERMONT FERRAND UR LISC FRA ; CEMAGREF CLERMONT FERRAND UR LISC FRA ; CEMAGREF CLERMONT FERRAND UR LISC FRA}, abstract = {We propose an algorithm which performs a progressive approximation of a viability kernel, iteratively using a classification method. We establish the mathematical conditions that the classification method should fulfill to guarantee the convergence to the actual viability kernel. We study more particularly the use of support vector machines (SVMs) as classification techniques. We show that they make possible to use gradient optimisation techniques to find a viable control at each time step, and over several time steps. This allows us to avoid the exponential growth of the computing time with the dimension of the control space. It also provides simple and efficient control procedures. We illustrate the method with some examples inspired from ecology. },}
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- O. Bokanowski, S. Martin, R. Munos, H. Zidani
  An anti-diffusive scheme for viability problems
  Applied Numerical Mathematics 56 (9), 2006 abs doi web bib The value function associated with viability problem is discontinuous. We investigate the Ultra-Bee scheme, particularly interesting for its anti-diffusive property in the transport of discontinuous functions. Our numerical results are very encouraging.close @article{PUB00020443, author = {Bokanowski, O. and Martin, S. and Munos, R. and Zidani, H.}, title = {An anti-diffusive scheme for viability problems}, title = {Un schéma anti-diffusif pour des problèmes de viabilité}, journal = {Applied Numerical Mathematics}, volume = {56}, number = {9}, pages = {1147-1162}, url = {http://cemadoc.irstea.fr/cemoa/PUB00020443}, doi = {http://dx.doi.org/doi:10.1016/j.apnum.2006.03.004}, year = {2006}, affiliation = {UNIVERSITE PIERRE ET MARIE CURIE LABORATOIRE JACQUES-LOUIS LIONSPARIS, ; CEMAGREF CLERMONT FERRAND LISC ; ECOLE POLYTECHNIQUE CENTRE DE MATHEMATIQUES PALAISEAU ; ENSTA PARIS}, abstract = {The value function associated

with viability problem is discontinuous. We investigate the Ultra-Bee scheme, particularly interesting for its anti-diffusive property in the transport of discontinuous functions. Our numerical results are very encouraging.},□}
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