

CURRICULUM VITAE

Smaïl Djebali

Updated on

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0.1 Web pages

1. <https://units.imamu.edu.sa/colleges/science/Admission/Pages/default.aspx>
2. www.ens-kouba.dz/tpfa/
3. https://www.researchgate.net/profile/Smail_Djebali/
4. <http://orcid.org/0000-0002-2318-1989>
5. Google Scholar Citations:
<http://scholar.google.fr/citations?user=mwyKeMsAAAAJ&hl=fr>
6. H-index=12
7. i10 index=16

0.2 CIVIL STATUS

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- Postal addresses: Department of Mathematics, Faculty of Sciences, Al Imam Mohammad Ibn Saud Islamic University (IMSIU), P.O. Box 90950, Riyadh 11623, Saudi Arabia
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- E-mail addresses: djebali@hotmail.com, ismail.djebali@imamu.edu.sa, djebali@ens-kouba.dz
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0.3 SPOKEN and WRITTEN LANGUAGES

Arabic: Native. French: Fluent. Written English: very good. Spoken English: good

0.4 EDUCATION

- 1962–1968: Elementary school
- 1968–1972: Intermediary school
- 1972–1975: Secondary school: Baccalaureate (High School degree) in Mathematics
- 1975–1979: Algiers University (U.S.T.H.B.): Higher Studies Diploma (D.E.S) (Bachelor) in Mathematical Analysis; option: Partial Differential Equations
- 1982–1983: Paris XI University, Orsay (France): Post-Graduate Studies Diploma (D.E.A.) (Master); option: Numerical Analysis
- 1983–1987: Paris XI University, Orsay (France): Third Grade Doctor French Degree in Mathematics (PhD); option: Numerical Analysis; theme: Ordinary Differential Equations
- 2001: Algiers University (U.S.T.H.B.), Doctorat ès Sciences (Science Doctorate) (Mathematics); option: Numerical Analysis; theme: Ordinary Differential Equations

0.5 RESEARCH INTERESTS

0.5.1 Past and recent

1. Mathematical investigation of traveling wave type solutions to some reaction-diffusion problems arising in biology and combustion theory.
2. Qualitative theory of second order ODEs.
3. Asymptotic integration of IVPs.
4. Dynamic equations on Time Scales.
5. Radial and vanishing solutions of some elliptic partial differential equations on exterior domains.

0.5.2 CURRENT

1. Geometry of Banach spaces.
2. Fixed point theory in metric spaces and Banach spaces with strong and weak topology.
3. Fixed point theory in Banach algebras.
4. Topological structure of solution set for differential equations and inclusions in Banach and Fréchet spaces.
5. Topological methods in fixed point theory with applications to: second-order BVPs, integral equations, differential and fractional inclusions, and functional differential equations and inclusions.
6. Variational methods in fixed point theory with applications to nonlinear problems.

0.5.3 Main fields of interest, key words and phrases

ODEs, PDEs, Continuation Methods, Reaction-diffusion Systems, Applied Analysis, Leray-Schauder Topological Degree and Index, Upper and Lower Solutions, Shooting and Topological Methods, Traveling Waves, Asymptotic Analysis, BVPs on Bounded and Unbounded Intervals, Asymptotic Integration Theory in ODEs, Dynamic Equations on Time Scales; Differential Inclusions; Topological and Geometric Structure of Solution Sets; Integral Equations; Functional Differential equations and Inclusions; Impulsive Equations; p and ϕ -Laplacian Problems; Abstract Nonlinear Problems in Metric Spaces and Banach Algebras; Fixed Point Theory in Metric Spaces and Banach Algebras.

M.S. Classification: 34A12, 34A34, 34A37, 34A40, 34A60, 34B15, 34B18, 34B24, 34B27, 34B37, 34B40, 34C11, 34D05, 34D20, 34D23, 34D40, 34E05, 34G20.

0.6 TEACHING, WORK EXPERIENCE

- 1977–1979: "Professeur de lycée": Mathematics teacher: Algiers undergraduate schools
- 1979–1982: "Teaching Assistant": Tutor at first and second grade Mathematics teaching: Algiers Higher School in Agronomy (I.N.A.)

- 1986–1988: "Maître auxilliaire": Mathematics teacher: Paris Suburbs secondary schools (Rectorat de Versailles, France)
- 1988–1989: "ATER" (Teaching Assistant): Tutor at the first grade and at the Bachelor Degree Preparation: Paris XI University (Orsay, France).
- 1989–1991: "Maître assistant": Assistant Professor (B) at the Teachers Higher Training School: École Normale Supérieure (E.N.S.-Kouba, Algiers)
- 1991–2001: "Chargé de Cours": Assistant Professor (A) (E.N.S.-Kouba, Algiers)
- 2001–2006: "Maître de conférences": Associate Professor (E.N.S.-Kouba, Algiers)
- July 2006–September 2015: Full professor (E.N.S.-Kouba, Algiers)
- October 2015–present: Full professor (Al Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh, Kingdom of Saudi Arabia)

0.7 TOPICS TAUGHT, TEACHING ASSIGNMENTS

1. Applied statistics in Agronomy (first grade)
2. Applied mathematics in Biology (first grade)
3. Analysis and Algebra (first grade)
4. Topology (second grade)
5. Numerical analysis of ODEs (third grade)
6. Mathematical logic (third and fourth grades)
7. Measure and integration theories (fifth grade)
8. Partial differential equations: analytic methods (seventh grade)
9. Qualitative theory of ODEs (magister and master certificate preparation)

10. Topological degree methods with applications to ODEs, PDEs (same level)
11. Second order nonlinear boundary value problems for ODEs (same level)
12. Multi-valued analysis and differential inclusions (same level)

0.8 DUTIES, POSITIONS HELD

1. 1991–1994: Responsible for the magister certificate preparation
2. 1992–1995: Responsible for the first grade teaching
3. 1991–1993: Deputy-head of the mathematics department
4. 1994–1996: Head of the mathematics department
5. 2001–2002 and 2004–2005: Responsible for the master certificate preparation
6. 2009–2012: Responsible for the master certificate preparation on "Ordinary Differential Equations"
7. September 2003–December 2012: Deputy-head in charge with post-graduate studies and scientific research

0.9 Scholarship

Grant from the Algerian Government, 1982–1986. Paris XI University, France

0.10 Award

Elsevier SCOPUS Award Winner in Mathematics: Algiers, 26 April 2012

0.11 Editorialship

Member of the Editorial Boards of the following two polish journals:

1. Journal of Mathematics and Applications
<http://www.prz.rzeszow.pl/matematyka/jma/>

2. *Discussiones Mathematicae Differential Inclusions, Control and Optimization*
<http://www.discuss.wmie.uz.zgora.pl/di/index.php>

0.12 REVIEWER

1. Since 2006, I act as a reviewer for *Zentralblatt für Mathematik* (European Mathematical Society, www.zentralblatt-math.org/zmath/en/). By December 2016, 144 reviews have been performed.
2. As of July 2009, I also act as a reviewer for *Mathematical Reviews* (American Mathematical Society, www.ams.org) (57 reviews performed on December 2016).
3. Research reviewer for King Fahd University for Petroleum and Minerals (KFUPM University), Dhahran, Saudi Arabia.
4. I serve as a reviewer for some international journals; so far (December 2016), 89 reports have been written for the following 50 journals: *Advances in Difference Equations* (Hindawi) (07), *Arab Journal Science and Engineering* (KFUPM, Saudi Arabia) (02), *Applied Math Letters* (Elsevier) (01), *Boundary value Problems* (Hindawi, Springer) (02), *Computers and Mathematics with Applications* (Elsevier) (02), *Electronic Journal Qualitative Theory of Differential Equations* (07), *Fixed Point Theory and Applications* (Hindawi, Springer) (02), *ICMSAO'09 Proceedings* (01), *Journal of Computational and Applied Mathematics* (Elsevier) (01), *Mathematics and Computer Modeling* (Elsevier) (03), *Maghreb Math Review* (Algeria) (05), *Nonlinear Analysis: T.M.A.* (Elsevier) (02), *Nonlinear Analysis: R.W.A.* (Elsevier) (01), *Rocky Mountain Journal of Mathematics* (RMM consortium) (01), *Topological Methods in Nonlinear Analysis* (Juliusz Schauder University Centre for Nonlinear Studies, Torun, Poland) (07), *Nonlinear Dynamics* (Springer) (01), *Mathematical Problems in Engineering* (Hindawi) (01), *Italian Journal of Pure and Applied Mathematics* (01), *Demonstratio Math* (Warsaw, Poland) (01), *Indian Journal of Mathematics/ Bulletin of the Allahabad Mathematical Society* (01), *Fixed Point Theory* (Cluj-Napoca, Romania) (01), *Journal of Applied Mathematics* (Hindawi) (01), *AIMS Proceedings* (01), *Journal of Differential Equations* (Elsevier) (01), *Journal of Inequalities and Applications* (Hindawi) (01), *Nonlinear Analysis: Hybrid Systems* (Elsevier) (01), *Surveys in Mathematics and its Applications* (University Constantin Brncusi of Trgu-

Jiu, Romania) (01), Numerical Functional Analysis and Optimization (Taylor and Francis) (01), Mathematical Modeling and Analysis (Taylor and Francis) (02), Nonlinear Studies (01), Electronic Journal of Differential Equations (02), Thai Journal of Mathematics (Chiang Mai University, Thailand) (01), Arab Journal of Mathematical Sciences (Springer) (02), Abstract and Applied Analysis (Hindawi) (05), Bulletin of the Malaysian Mathematical Sciences Society (01), Journal of Abstract Differential Equations and Applications (Mathematical Research Publishers) (01), Positivity (Springer) (01), Mediterranean Journal of Mathematics (Springer) (03), Annals Polinici Mathematici (Institute of Mathematics, Polish Academy of Sciences) (01), Scientific Journal Facta Universitatis (University of Nis, Serbia) (01), Bulletin of the Iranian Mathematical Society (01), Journal of Function Spaces (Hindawi) (02), Bulletin of the London Mathematical Society (01), Annals of the "Al. I. Cuza" University-Mathematics (Iasi, Romania, De Gruyter) (01), Mathematical Methods in the Applied Sciences (John Wiley & Sons) (01), Journal of Nonlinear and Convex Analysis (Yokohama Publishers, Japan) (01), Journal of Fixed Point Theory and Applications (Springer) (01), Arabian Journal of Mathematics (Elsevier) (01), Asian Journal of Mathematics and Computer Research (International Knowledge Press, UK) (01), Journal of Nonlinear Sciences and Applications (International Scientific Research Publications (ISRP)) (01).

0.13 SUPERVISING DISSERTATIONS

0.13.1 Magister certificates

1. O. Saifi, "Méthode des sous et sur-solutions en EDOs et applications aux oscillateurs forcés singuliers". Defended March 25, 2004
2. S. Zahar, "Méthode des sous et sur-solutions en EDOs et applications aux problèmes de Dirichlet Singuliers". Defended March 25, 2004
3. K. Bachouche, "Sur la condition de croissance de Nagumo-Bernstein en théorie des EDOs". Defended October 2nd, 2005
4. K. Mebarki, "Théorèmes de point fixe sur les cônes et applications à des problèmes aux limites non linéaires associés aux EDOs". Defended March, 16th, 2006

5. K. Foukrache, "Théorie de l'intégration asymptotique des EDOs". Defended June 19th, 2007
6. S. Mellal, "Problèmes aux limites associés aux EDOs du second ordre sur les intervalles non bornés". Defended, June 23rd, 2008
7. F. Korichi, "Problèmes aux limites du second ordre associés aux équations dynamiques sur les échelles de temps". Defended, January 19th, 2009
8. F. Mesri, "Mesures de non compacité, opérateurs condensants et applications". Defended, December 16th, 2009 (Univ. Sidi-Bel-Abbès)
9. M.S. Souid, "Problèmes aux limites d'EDO à conditions aux bords intégrales". Defended May 26th, 2010 (Univ. Sidi-Bel-Abbès)
10. M. Bessadat, "Critères de compacité sur les intervalles non bornés et applications". Defended October 13th, 2011.
11. L. Guedda, "Degré topologique et problèmes aux limites". Defended November 25, 2012 (Univ. Ouargla)
12. Z. Bounegab, "Degrés topologiques pour les applications multivoques et applications". Defended October 12, 2013.
13. A. Ghendir-Aoun, "Problèmes aux limites non locaux". Defended October 12, 2013.
14. B. Boulfoul, "Équations intégrales non linéaires de type Volterra ou Hammerstein". Defended February 26, 2015.
15. S. Benchabane, "Théorie du point fixe multivoque". Defended June 16, 2015.
16. A. Aouane, "Conditions aux bords et conditions intérieures en théorie du point fixe". Defended June 27, 2015.

0.13.2 Phd dissertations

1. T. Moussaoui, "Problèmes aux limites associés à des EDO du second ordre non linéaires" ("BVPs for nonlinear second-order ODEs"). Defended June 3rd, 2007
2. K. Mebarki, "Résultats d'existence pour des EDO non linéaires" ("Existence results for some nonlinear ODEs"). Defended, April 22nd, 2010

3. O. Saifi, "Problèmes aux limites du second ordre sur les intervalles non bornés" ("Second order BVPs on unbounded intervals"). Defended, January 23 rd, 2011
4. K. Hammache, "Sur la théorie du point fixe dans des espaces métriques, et applications" ("Fixed point theory in metric spaces, and applications"). Defended, 23 June 2011
5. Z. Sahnoun, "Théorie du point fixe pour les sommes et produits d'opérateurs dans des espaces localement convexes, et applications" ("Fixed point theory for sums and products of operators in locally convex spaces, and applications"). Defended, 23 June 2011
6. S. Zahar, "Résultats d'existence pour des problèmes aux limites du second ordre sur les intervalles bornés et non bornés" ("Existence theory for some second order BVPs on bounded and unbounded intervals"). Defended, 02 January 2012
7. K. Bachouche, "Résultats d'existence pour des problèmes de Sturm-Liouville non linéaires" ("Existence theory for nonlinear Sturm-Liouville problems"). Defended, 24 June 2012
8. K. Foukrache, "Résolution de certaines équations différentielles fractionnaires" ("Solvability of some fractional differential equations") (with Mokhtar Kirane, La Rochelle, France and Toufik Moussaoui, ENS-Kouba, Algiers). Defended, 22 June 2014
9. F. Madjidi, "Résultats d'existence pour des problèmes aux limites dans des espaces de Banach" ("Existence results for some BVPs in Banach spaces"). (with K. Mebarki, Bejaia University). Defended January 2016
10. O. Benniche, "Étude de quelques problèmes de viabilité décrits par des inclusions différentielles ordinaires et discrètes" ("On some viability problems for some ordinary and discrete differential inclusions"). (with O. Carja, West University of Timișora, Romania) (expected, December 2016)
11. F. Korichi, "Équations différentielles impulsives et stochastiques" ("Impulsive and stochastic differential equations"), In preparation since December 2009 (with Hisao Fujita Yashima, Turin University, Italy) (expected, December 2016)

12. Z. Benbaziz, "Problèmes aux limites d'ordre trois" (On some BVps for third-order differential equations"). In preparation since January 2012 (in progress)
13. L. Guedda, "Étude de quelques problèmes aux limites en résonance" ("On some resonant BVPs"). In preparation since December 2012 (in progress)
14. L. Benhammouche, "Contribution à l'étude des équations intégrales non linéaires sur les intervalles bornés ou non bornés". In preparation since December 2014 (in progress)
15. S. Seghiri, "Contribution à la théorie du point fixe et ses applications en analyse multivoque" ("Contribution to the theory of multivalued fixed point theory, and applications"). In preparation since December 2012
16. Z. Bounegab, "Méthodes topologiques en analyse multivoque et applications" ("Topological methods in multivalued analysis, and applications"). In preparation since January 2014
17. A. Ghendir-Aoun, "Problèmes aux limites non locaux" ("On some non-local BVPs"). In preparation since January 2014
18. A. Aouane, "Contributions en théorie du point fixe métrique" ("Contribution to the metric fixed point theory") (with T. Moussaoui, ENS, Kouba, Algiers). In preparation since October 2015
19. B. Boulfoul, "Étude de quelques équations intégrales fonctionnelles" ("On some functional integral equations") (with T. Moussaoui, ENS, Kouba, Algiers). In preparation since October 2015
20. S. Benchabane, "Théorie du point fixe multivoques dans des espaces métriques munis de graphes" ("Multivalued fixed point theory in metric spaces with graph") (with T. Moussaoui, ENS, Kouba, Algiers). In preparation since October 2015

0.14 ORGANIZED CONFERENCES, WORKSHOPS, SEMINARS

1. Rencontre internationale des mathématiciens algériens (RMA 2000); Algiers, 21–23 May 2000 (celebration of 2000 World Mathematical Year in Algeria) (co-organizer)

2. 6ème Colloque International d'Histoire des Mathématiques Arabes (CoMHisMA'6 2000); Algiers, 20–22 November 2000 (co-organizer)
3. École CIMPA (CIMPA School), "Riemannian and Pseudo-Riemannian Geometries and Dynamics, and Applications"; El-Oued (Algeria), February 26–March 10, 2005 (co-organizer)
4. Colloque "Équations aux Dérivées Partielles", Tipaza (Algeria), May 23–26, 2005 (co-organizer)
5. 1st Symposium–School on "Ordinary Differential Equations", Tipaza (Algeria), May 13–18, 2006 (organizer)
6. 2nd Symposium–School on "Ordinary Differential Equations", Jijel (Algeria), May 19–24, 2007 (co-organizer)
7. 3rd Symposium–School on "Ordinary Differential Equations", Mostaganem (Algeria), May 24–29, 2008 (co-organizer)
8. 4th Symposium–School on "Ordinary Differential Equations", Tlemcen (Algeria), May 23–27, 2009 (scientific committee)
9. 5th Symposium–School on "Ordinary Differential Equations", Guelma (Algeria), June 06–10, 2010 (scientific committee, co-organizer)
10. Responsible for a "Research Working Group on Ordinary Differential Equations", 2002–2015, E.N.S.-Kouba (Algiers, Algeria)

0.15 ATTENDED CONFERENCES

1. Spring School on "Evolution Problems", September 10–October 5 1990, Trieste (Italy)
2. 2nd European Conference on Parabolic and Elliptic Problems, June 1994, Pont-à-Mousson (France)
3. 3rd European Conference on Parabolic and Elliptic Problems, June 1996, Pont-à-Mousson (France)
4. Congrès National de Mathématiciens Algériens, May 17–19, 1999, Annaba (Algeria)
5. Rencontre 2000 des Mathématiciens Algériens, May 21–24, 2000, Algiers (Algeria)

6. IIIème Colloque National d'Analyse Fonctionnelle et Applications, April 17–18, 2001, Ouargla (Algeria)
7. IIIème Rencontre Internationale d'Analyse Mathématiques et ses applications, May 21–23, 2002, Béjaia (Algeria)
8. Autumn School on Delay Differential Equations: Theory and Applications (CIMPA School), September 9–21, 2002, Marrakech (Morocco)
9. EDP2002: Colloque International d'EDP, October 27–29, 2002, Algiers (Algeria)
10. Contrôle non linéaire et Applications (CIMPA School), April 26–May 8, 2003, Tlemcen (Algeria)
11. Première Conférence Internationale sur les Modèles et Méthodes Mathématiques et Informatiques en Dynamique de Population, May 10–12, 2003, Tlemcen (Algeria)
12. 12ème Colloque de la SMT (Tunisian Mathematical Society), March 15–18 2004, Mahdia (Tunisia)
13. Colloque International sur les Mathématiques Appliquées l'Industrie et la Physique, 21–23 Avril 2004, El-Djadida (Morocco) (Invited speaker)
14. ICME 10: 10th International Congress on Mathematical Education, 4–11 July 2004, Copenhagen (Denmark)
15. École CIMPA (CIMPA School), "Riemannian and Pseudo-Riemannian Geometries and Dynamics, and Applications"; El-Oued (Algeria), February 26–March 10, 2005
16. Colloque "Équations aux Dérivées Partielles", May 23–26, 2005, Tipaza (Algeria)
17. École-Symposium "Inclusions différentielles et théorie du contrôle", Sidi-Bel-Abbès (Algeria), March 25–30, 2006
18. First Symposium-School on "Ordinary Differential Equations and Inclusions", May 13–18, 2006, Tipaza (Algeria)
19. Marrakesh World Conference on Differential Equations and Applications: June 15–20, 2006, Marrakech (Morocco)
20. 15ème Colloque de la SMT (Tunisian Mathematical Society), March 19–22, 2007, Sousse (Tunisia)

21. "Deuxièmes Journées Méditerranéennes de Mathématiques Appliquées", March 22–27, 2007, Monastir (Tunisia)
22. Second Symposium-School on "Ordinary Differential Equations and Inclusions", May 19–24, 2007, Jijel (Algeria)
23. Des Équations aux Dérivées Partielles au Calcul Scientifique, Congrès en l'honneur de Luc Tartar à l'occasion de son Soixantième Anniversaire, 2–6 juillet, 2007, Ancienne École Polytechnique, Paris (France)
24. Fifth Symposium on Nonlinear Analysis, September 10–14, 2007, Toruń (Poland)
25. École-Symposium "Équations Différentielles et Géométrie Différentielle", EDGD07, November 11–14, 2007, Saida (Algeria)
26. Third Symposium-School on "Ordinary Differential Equations", May 24–29, 2008, Mostaganem (Algeria)
27. CNAMA5, Bejaia (Algeria), April 13-14, 2009
28. Fourth Symposium-School on "Ordinary Differential Equations", May 23–27, 2009, Tlemcen (Algeria)
29. Workshop on "Control Theory and Applications", Monastir (Tunisia), 19-22 November 2009
30. Fifth Symposium-School on "Ordinary Differential Equations", June 06–10, 2010, Guelma (Algeria)
31. Workshop on "Nonlinear Analysis and Applications". Monastir (Tunisia), December 16-19, 2010
32. Workshop on "Nonlinear Analysis and Applications". Monastir (Tunisia), December 16-20, 2011
33. "Journées d'Analyse et d'Approximation d'EDP", JAAEDP' 2012. Tipaza, June 09-11, 2012
34. ATIM2012, "Algerian-Turkish Days on Mathematics". Annaba, October 09-11, 2012
35. Workshop on "Nonlinear Analysis and Applications". Mahdia (Tunisia), December 16-20, 2012

36. "1er Colloque National sur la Théorie des Opérateurs et ses Applications", El-Oued, March 11-13, 2013
37. "International Conference on Advances in Applied Mathematics". Hammamet (Tunisia), December 16-19, 2013
38. "International Conference on Advances in Applied Mathematics". Hammamet (Tunisia), December 22-25, 2014

0.16 SCIENTIFIC VISITS

I have undertaken scientific visits to ICTP (Trieste, Italy) (1990), Institut Elie Cartan (Nancy University, France) (1990-1992), Jean Dieudonné Laboratory (Nice University, France (2008), Schauder Center for Nonlinear Studies (Torún University, Poland) (2007, 2010), Department of Mathematics, Sfax University, Tunisia (2009-2014), Jacques-Louis Lions Laboratory (Paris VI, Pierre et Marie-Curie University, France) (several times between 1992 and 2015), Department of Mathematics and Statistics, KFUPM, Dhahran, Saudi Arabia (06 April-19 April, 2015)

0.17 Communications

0.17.1 Proceedings of Conferences

1. Modeling and Mathematical Methods in Combustion Theory and Control of Epidemics, "CIMMIDPI-03", pp. 81–90 (In "Première Conférence Internationale sur les Modèles et Méthodes Mathématiques et Informatique en Dynamique de Population", 10–12, May 2003, Tlemcen, Algeria)
2. The practice of Teaching Tertiary Mathematical Analysis, ICME10, (In TSG13, 4–11 July 2004, Copenhagen, Denmark), pp. 1–12. Full text: Teaching mathematical analysis at first university level, unpublished, 41 pages (2003)
3. Boundary Value Problems on Unbounded Domains, EDGD07, November 11–14, Saida (Algeria), Tome 1, pp. 1–34
4. "Applied Mathematics in Tunisia", Proceedings of the "International Conference on Advances in Applied Mathematics" (ICAAM), Hammamet, Tunisia, December 2013. Series: Springer Proceedings in Mathematics & Statistics, Vol. 131 (2015). Applied Mathematics in Tunisia

International Conference on Advances in Applied Mathematics (ICAAM), Hammamet, Tunisia, December 2013 Editors: Jeribi, Aref, Hammami, Mohamed Ali, Masmoudi, Afif
<http://www.springer.com/us/book/9783319180403>

0.17.2 Oral Communications

1. "Existence d'ondes progressives pour un système de réaction-diffusion avec sources extérieures", "CNAMA1", Annaba (Algeria), May, 17–19, 1999
2. "About a linear differential equation arising in epidemiology", joint work with O. Kavian (Versailles University), "RMA2000", Algiers, May, 21–23, 2000
3. "Travelling wave solutions to some typical reaction-diffusion systems from combustion theory", "CNAFA3", Ouargla (Algeria), April, 17–19, 2001
4. "Travelling wave solutions to a reaction-diffusion system from combustion theory", "Summer School on Delay Differential Equations", Marrakech (Morocco) September, 9–21, 2002.
5. "Ondes progressives pour un système de réaction-diffusion", "EDP2002", October 27–29, 2002, USTHB, Algiers (Algeria)
6. "Modelling and mathematical methods in combustion theory and control of epidemics", "CIMMIDPI 03", May, 10–12, 2003, Tlemcen (Algeria)
7. "IVPs for some classes of 2nd order nonlinear ODEs", "12ème Colloque de la SMT", 15–18 mars 2004, Mahdia (Tunisia)
8. "Traveling wave solutions to reaction-diffusion systems in epidemiology and combustion theory: modeling and mathematical results", "CIMAIP04", 21–23 April 2004, El-Djadida (Morocco)
9. "The practice of teaching tertiary mathematical analysis", in TSG13, "ICME10, 4–11 July 2004, Copenhagen (Denmark)
10. "Fixed point theory for sum of nonlinear operators", 1st Symposium-School on "Ordinary Differential Equations", May 13-1-8, 2006, Tipaza (Algeria)

11. A class of second order BVPs on infinite intervals, "Marrakesh World Conference on Differential Equations and Applications", June 15–20, 2006, Marrakech (Morocco)
12. "Existence and multiplicity of solutions for φ -Laplacian boundary value problems", "Journées sur les équations différentielles", January 21–26, 2007, Sfax (Tunisia)
13. "Existence results for a generalized Fisher-like equation", "Colloque de la SMT", March 19–22, 2007, Sousse (Tunisia)
14. "Positive evanescent solutions to semilinear partial differential equations on exterior domains", "Deuxièmes Journées Méditerranéennes de Mathématiques Appliquées", March 22–27, 2007, Monastir (Tunisia)
15. "Fixed point index in cones with applications to integral equations", "2nd Symposium-School on "Ordinary Differential Equations", May 19–24, 2007, Jijel (Algeria)
16. "Multiplicity results for a class of singular BVPs on the positive half-line", "5th Symposium on Nonlinear Analysis", September 10–14, 2007, Toruń (Poland)
17. "Boundary value problems on unbounded domains", EDGD07, November 11–14, Saida (Algeria)
18. "Sign-changing singular boundary value problems", "3rd Symposium-School on "Ordinary Differential Equations", May 24–29, 2008, Mostaganem (Algeria)
19. "First-order periodic impulsive semilinear differential inclusions: existence and structure of solution sets", Workshop on "Control Theory and Applications", Monastir, 19-22 November 2009
20. "Structure of solution sets for first-order periodic impulsive semilinear differential inclusions", weakly seminar Toruń University and University of Technology, Warsaw (Poland), January 2010
21. "Topological structure of solution sets for impulsive differential inclusions", Fifth Symposium-School on "Ordinary Differential Equations", June 06–10, 2010, Guelma (Algeria)
22. "Topological structure of solution sets for impulsive differential inclusions in Fréchet spaces", Workshop on "Nonlinear Analysis and Applications". Monastir, December 16-19, 2010

23. "Second-order impulsive differential inclusions", Workshop on "Nonlinear Analysis and Applications". Monastir, December 16-20, 2011
24. "Fixed point theory: old and new", "Algerian-Turkish Days on Mathematics", Annaba, October 09-11, 2012
25. "Recent results on fixed point theory", Workshop on "Nonlinear Analysis and Applications". Monastir, December 16-20, 2012
26. "Integral and operational equations in weak topology", "1er Colloque National sur la théorie des opérateurs et ses applications", El-Oued, March 11-13, 2013
27. "Fixed point theory for 1-set contractions", "International Conference on Advances in Applied Mathematics". Hammamet (Tunisia), December 16-19, 2013
28. "Application of Morse theory to the solvability of some BVPs", "International Conference on Advances in Applied Mathematics". Hammamet (Tunisia), December 22-25, 2014

0.18 PUBLICATIONS

0.18.1 Dissertations

1. "Doctorat 3ème cycle" ("PhD"): French Thesis in Paris XI University, December 12th, 1987 (in French). Title: "Mathematical Problems of Nonadiabatic Laminar Flames". Option: Numerical Analysis; theme: Ordinary Differential Equations. Supervisor: B. Scheurer; president of the viva: R. Temam
2. "Doctorat d'état" ("Science Doctorate"): Thesis of Doctorate ès Mathématiques Sciences at Algiers University, May 5th, 2001 (in English). Title: "Existence of Travelling Waves for some Reaction-diffusion Systems arising in Epidemiology and Combustion Theory". Option: Numerical Analysis; theme: Ordinary Differential Equations. Supervisor: M.S. Moulay; president of the viva: D. Teniou

0.18.2 Papers: 79 papers published (or accepted for publication) with 33 collaborators

1. Mathematical analysis of nonadiabatic laminar flames. Part I: Existence of solutions, Maghreb Mathematical Review, Vol. 7, No 1 (1998)

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2. Mathematical analysis of nonadiabatic laminar flames. Part II: asymptotic analysis, *Maghreb Mathematical Review*, Vol. 7, No 2 (1998) 71–94
3. Existence of travelling waves for a model from epidemiology, *Arab Journal of Mathematical Sciences*, Vol. 7, No 1 (2001) 53–75 (<http://www.journals.elsevier.com/arab-journal-of-mathematical-sciences/>)
4. Travelling wave solutions to a reaction-diffusion system arising in epidemiology, *Nonlinear Analysis, Series B, Real World Applications*, Vol. 2, No 4 (2001) 417–442 (<http://www.journals.elsevier.com/nonlinear-analysis-real-world-applications/>)
5. Traveling front Solutions for a diffusive epidemic model with external sources, *Annales de la Faculté des Sciences de Toulouse, S.6*, Vol. 10, No 2 (2001) 271–292 (<http://afst.cedram.org/>)
6. Uniform continuity and growth of real continuous functions, *International Journal Mathematical Education in Science and Technology*, Vol. 32, No 5 (2001) 677–689 (<http://www.tandfonline.com/toc/tmes20/>)
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9. Boundary value problems for doubly perturbed first order ordinary differential systems (joint work with M. Benchohra and T. Moussaoui), *Electronic Journal of Qualitative Theory of Differential Equations*, No 11 (2006) 1–10 (<http://www.math.u-szeged.hu/ejqtde/>)
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11. Existence results for a class of BVPs on the positive half-line (joint work with K. Mebarki), *Communication on Applied Nonlinear Analysis*, Vol.

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12. On the asymptotic integration of nonlinear differential equations (joint work with R.P. Agarwal, T. Moussaoui and O.G. Mustafa), *Journal Computational and Applied Mathematics*, Vol. 202, No 2 (2007) 352–376
(<http://www.journals.elsevier.com/journal-of-computational-and-applied-mathematics/>)
13. Positive evanescent solutions of nonlinear elliptic equations (joint work with T. Moussaoui and O.G. Mustafa), *Journal Mathematical Analysis and Applications*, Vol. 333, No 2 (2007) 863–870
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14. Multiple positive solutions for ϕ -Laplacian BVPs (joint work with A. Benmezai, and T. Moussaoui), *PanAmerican Mathematical Journal*, Vol. 17, No 3 (2007) 53–73 (<http://www.internationalpubs.com/>)
15. On the asymptotic behavior of solutions to nonlinear ordinary differential equations (joint work with R.P. Agarwal, T. Moussaoui, O.G. Mustafa, and Y. Rogovchenko), *Asymptotic Analysis*, 54 (2007) 1–50
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17. Positive solutions for ϕ -Laplacian Dirichlet BVPs (joint work with A. Benmezai, and T. Moussaoui), *Fixed Point Theory*, Vol. 8, No 2 (2007) 167–186 (www.math.ubbcluj.ro/nodeacj/sfptej.html)
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19. Multiple positive solutions for singular bvps on the positive half-line (joint work with K. Mebarki), *Computers and Mathematics with Applications*, Vol. 55, No 12 (2008) 2940–2952
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21. Furi-Pera Fixed point theorems in Banach algebras with applications (joint work with K. Hammache), *Acta Univ. Palacki. Olomuc., Fac. rer. nat., Mathematica* 47 (2008) 55–75 (http://mant.upol.cz/cs/acta_math.asp)
22. On the singular generalized Fisher-like equation with derivative depending nonlinearity (joint work with K. Mebarki), *Applied Mathematics and Computations*, Vol. 205, No 1 (2008) 336–351 (<http://www.journals.elsevier.com/applied-mathematics-and-computation/>)
23. Filippov-Ważewski theorems and structure of solution sets for first order impulsive semilinear functional differential inclusions (joint work with L. Górniewicz and A. Ouahab), *Topological Methods in Nonlinear Analysis*, Vol. 32, No 2 (2008) 261–312 (<http://www.tmna.ncu.pl/>)
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26. Existence and multiplicity results for singular ϕ -Laplacian BVPs on the positive half-line (joint work with K. Mebarki), *Electronic Journal of Differential Equations* Vol. 2009, No 103, (2009) 1–13 (<http://ejde.math.txstate.edu/>)
27. Positive solutions for singular ϕ -Laplacian BVPs on the positive half-line (joint work with O. Saifi), *Electronic Journal of Qualitative Theory of Differential Equations*, No 56, (2009) 1–24 (<http://www.math.u-szeged.hu/ejqtde/>)
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29. Fourth order p -laplacian nonlinear systems via the vector version of the Krasnosel'skiĭ's fixed point theorem (joint work with T. Moussaoui and R. Precup), *Mediterranean Journal of Mathematics*, Vol. 6, No 4, (2009) 449–463 (<http://www.springer.com/birkhauser/mathematics/journal/9>)
 30. Multiple unbounded positive solutions for three-point BVPs with sign-changing nonlinearities on the positive half-line (joint work with K. Mebarki), *Acta Applicandae Mathematicae*, 109, (2010), 361–388 (<http://link.springer.com/journal/10440>)
 31. Existence de géodésiques d'un groupe de difféomorphismes muni d'une Métrique de Sobolev (joint work with N. Hermas), *African Diaspora Journal of Mathematics*, Vol. 9, Number 1, (2010) 50–63 (<http://math-res-pub.org/adjm>)
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 33. Existence results for ϕ -Laplacian Dirichlet BVPs of differential inclusions with applications to control theory (joint work with A. Ouahab), *Discussiones Mathematicae Differential Inclusions, Control and Optimization*, Vol. 30 (2010) 23–49 (<http://www.discuss.wmie.uz.zgora.pl/di/>)
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36. Fixed point theorems for nonexpansive mappings in Banach spaces (joint work with K. Hammache), *Nonlinear Analysis* 73 (2010) 3440–3449 (2nd hottest article, July-September 2010: <http://top25.sciencedirect.com/subject/mathematics/16/journal/nonlinear-analysis-theory-methods-applications/0362546X/archive/28/>)
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38. Existence de l'application exponentielle riemannienne d'un groupe de difféomorphismes muni d'une métrique de Sobolev (joint work with N. Hermas), *Journal de Mathématiques Pures et Appliquées*, 94 (2010) 433–446 (<http://www.journals.elsevier.com/journal-de-mathematiques-pures-et-appliquees/>)
39. Bounded solutions for a derivative dependent boundary value problem on the half-line (joint work with S. Zahar), *Dynamical Systems and Applications*, 19 (2010) 545–556 (<http://www.dynamicpublishers.com/DSA/>)
40. Upper and lower solutions for singular ϕ -Laplacian BVPs with derivative depending nonlinearity on $[0, +\infty)$ (joint work with O. Saifi), *Communications in Applied Analysis*, 14 (2010), No. 4, 463–480 (<http://www.dynamicpublishers.com/CAA/>)
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42. Topological structure of solutions sets for impulsive differential inclusions in Fréchet spaces (joint work with L. Górniewicz and A. Ouahab), *Nonlinear Analysis, T.M.A.*, 74 (2011), No. 10, 2141–2169 (<http://www.journals.elsevier.com/nonlinear-analysis-theory-methods-and-applications/>)
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45. Boundary value problems of differential inclusions with Riemann-Liouville fractional derivative (joint work with M. Benchohra and S. Hammani), *Nonlinear Oscillations*, Vol. 14, No 1 (2011) 7–20 (<http://link.springer.com/journal/11072>)
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55. Third Order BVPs with ϕ -Laplacian Operators on $[0, +\infty)$ (joint work with O. Saifi), *African Diaspora Journal of Mathematics*, Volume 16, Number 1 (2013), 1–17 (<http://math-res-pub.org/adjm>)
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57. System of singular second-order differential equations with integral condition on the positive half-line (joint work with K. Mebarki), *Electronic Journal of Qualitative Theory of Differential Equations*, Vol. 2013, No 50, (2013) 1–41 (<http://www.math.u-szeged.hu/ejqtde/>)
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65. Existence results for systems of ϕ -Laplacian three-point boundary value problems on the positive half-line (joint work with K. Mebarki), UMZh, Ukrainskyi Matematychnyi Zhurnal, (Vol. 67, N 12, 2015), 1626-1648
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66. Multiple solutions for boundary value problems on the half-line via Morse theory and $H_p^1(\mathbb{R}^+)$ versus $C_p^1(\mathbb{R}^+)$ local minimizers (joint work with K. Ait-Mahiout and T. Moussaoui), Arabian Journal of Mathematics, Vol. 5, No 1, (2016), 9–22
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76. Third order boundary value problems with nonlinear growth at resonance on the half-line (joint work with L. Guedda), Mathematical Methods in the Applied Sciences, to appear ([http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1099-1476](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-1476))
77. Impulsive boundary value problems on the half-line via critical point theory (joint work with M. Briki and T. Moussaoui), Bulletin of the Iranian mathematical Society (<http://bims.iranjournals.ir/>), to appear
78. Positive solution to semi-positone fourth-order ϕ -Laplacian problem (joint work with A. Benmezai and K. Bachouche), in press, Positivity DOI 10.1007/s11117-016-0415-3 (<http://link.springer.com/journal/11117>)

79. Approximate viability for fully nonlinear differential inclusions (joint work with O. Benniche and O. Carja), *Mathematics and its Applications / Annals of AOSR*, to appear
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80. **Corrigendum to:** "Multiple positive solutions of multi-point boundary value problem on the half-line" [*Appl. Math. Comput.*, Vol. 196, Issue 1, (2008) 402–415], Rejected by the concerned journal "*Appl. Math. Comput.*" (7 pages).
81. Krasnosel'skii type fixed point theorem in ordered Banach space (joint work with A. Boucenna and T. Moussaoui), submitted
82. On Quadratic Integral Equations of Volterra type in Fréchet Spaces (joint work with L. Benhamouche), submitted

0.18.3 Textbooks (polycopiés)

1. "The Foundation of the Mathematical Logic" (in Arabic), (joint work with Youcef Guergour), dept. of Mathematics E.N.S.-Kouba, Algiers, 1994
2. "A Problem Book on the Qualitative Theory of Ordinary Differential Equations, Dept. of Mathematics E.N.S.-Kouba, Algiers, 1996
3. "Le degré topologique: théorie et applications", Textbook, Dept. of Mathematics, E.N.S.-Kouba, Algiers, 2006
4. " Problèmes aux limites associés aux E.D.O. du second ordre, Textbook, Dept. of Mathematics E.N.S.-Kouba, Algiers, 2006
5. "Analyse multivoque et inclusions différentielles, (joint work with Abdelghani Ouahab, Univ. Sidi-Bel-Abbès), Textbook, Dept. of Mathematics E.N.S.-Kouba, Algiers, 2008
6. " Théorie qualitative des EDO, Dept. of Mathematics E.N.S.-Kouba, Algiers, in preparation
7. "A course on Mathematical Analysis" (in Arabic), Dept. of Mathematics E.N.S.-Kouba, Algiers, in preparation.

0.18.4 Lecture Notes, Books

1. "Existence and Structure of Solution Sets for Impulsive Differential Inclusions: a Survey" (joint work with L. Górniewicz and A. Ouahab), *Lecture Notes of the Schauder Center for Nonlinear Studies (Toruń, Poland)*, Vol. 13, Feb. 2012 (pp. 148)

- *Zentrablatt Review by M. Benchohra (Sidi-Bel-Abbès, Algeria).*

In this survey paper, the authors present some existence results of mild solutions and the topological structure of solutions sets for first order impulsive semilinear differential inclusions with initial and periodic boundary conditions. This survey paper is organized in seven chapters. Chapter one (*Introduction*) contains, as motivation, some models in which impulsive effects occur. Chapter two (*Background material*) is devoted to some definitions and preliminary results on multivalued analysis, measure of noncompactness, semigroups and fixed point theorems. In chapter three (*Impulsive differential inclusions*), some existence results are presented for impulsive differential inclusions with convex as well as nonconvex valued right hand side. Also the structure of the solution sets is considered. In Chapter four (*The periodic problem*), sufficient conditions for the existence of mild solutions for impulsive semilinear differential inclusions with periodic conditions are presented. In Chapter five (*Impulsive functional differential inclusions*), the existence of mild solutions and the topological structure for impulsive functional differential inclusions with finite delay are considered. Chapter six (*Impulsive differential inclusions on half-time*), is devoted to existence of solutions and the topological structure of the solution sets for impulsive differential inclusions on the half-line. In the last chapter (*Concluding remarks*) one can find some useful remarks related to the problems considered in the present survey paper. At the end 148 items as references are presented.

This survey paper is well written by known specialists in the subject of impulsive differential inclusions, and contains latest progress on the subject. It will be useful for mathematicians, biologists and engineering researchers.

MSC 2000: 34-02 Research monographs (ordinary differential equations); 34A37 Differential equations with impulses; 34A60 ODE with multivalued right-hand sides; 34K30 Functional-differential equations in abstract spaces; 34K45 Equations with impulses; 34G25 Evolution inclusions; 34K09

Keywords: impulsive differential inclusions; mild solution; solution set;

topological structure; semigroup; fixed point; Banach space; half-line

- *MathScinet Review by Rodrigo L. Pouso, Santiago del Compostela, Spain.*

This book is a well-written, complete and up-to-date survey on properties of solution sets of first-order impulsive differential inclusions. Researchers will find this book very helpful for looking up recent results and references. On the other hand, its clear and almost self-contained expository style makes this book recommended reading for anyone who intends to start specialized research on solution sets of impulsive inclusions, or just to quickly have a detailed view of the state of the art of this subject. The variety of specialized techniques employed, ranging from nonlinear functional analysis to algebraic topology, yield deep results and may attract the attention of different types of researchers. In this sense, the authors should be praised for their successful efforts in writing clearly many technical and involved proofs. The book contains seven chapters, which we proceed to review separately.

Chapter 1 is an introduction containing some mathematical models with impulsive differential equations as a motivation. A real-life model with impulsive inclusions would improve this part. The introduction then follows with a description of subsequent contents and a concise bibliographical overview of their evolution.

Chapter 2 brings together many fundamental concepts and results which will be used in the rest of the book. As indicated by its title ("Background material"), most of the information in this chapter can be found in textbooks, but readers will undoubtedly appreciate having it just a few pages back. Chapter 2 contains basic definitions and results on multivalued analysis (including existence of measurable selections, decomposability and continuous selections,...), algebraic topology (the Aronsztain-Browder-Gupta theorem and limits of inverse systems of topological spaces), measures of noncompactness, C_0 -semigroups and fixed point theorems.

Chapter 3 concerns the following impulsive problem:

$$\begin{cases} (y' - Ay)(t) \in F(t, y(t)), & \text{a.e. } t \in J', \\ \Delta y_{t=t_k} = I_k(y(t_k^-)), & k = 1, \dots, m, \\ y(0) = a, \end{cases} \quad (0.18.1)$$

where $0 = t_0 < t_1 < \dots < t_m < t_{m+1} = b$, $J = [0, b]$, and $J' = J \setminus \{t_1, \dots, t_m\}$, $F: J \times E \rightarrow \mathcal{P}(E)$ is a multifunction, and $a \in E$. The

operator A is the infinitesimal generator of a C_0 -semigroup $\{T(t)\}_{t \geq 0}$ on a separable Banach space $(E, |\cdot|)$, $I_k \in C(E, E)$ ($k = 1, \dots, m$), and $\Delta y|_{t=t_k} = y(t_k^+) - y(t_k^-)$. The notations $y(t_k^+) = \lim_{h \rightarrow 0^+} y(t_k + h)$ and $y(t_k^-) = \lim_{h \rightarrow 0^+} y(t_k - h)$ stand for the right and the left limits of the function y at $t = t_k$, respectively. As usual, solutions are sought for in the Banach space

$$PC = \{y: [0, b] \rightarrow E, y_k \in C(J_k, E), k = 0, \dots, m, \text{ such that } y(t_k^-) \text{ and } y(t_k^+) \text{ exist and satisfy, } y(t_k^-) = y(t_k) \text{ for } k = 1, \dots, m\}.$$

endowed with the supremum norm. A mild solution to (0.18.1) is defined as some $y \in PC$ for which there exists some $v \in L^1(J, E)$ such that $v(t) \in F(t, y(t))$ almost everywhere in J , and

$$y(t) = T(t)a + \int_0^t T(t-s)v(s)ds + \sum_{0 < t_k < t} T(t-t_k)I_k(y(t_k^-)).$$

A first result for Carathéodory compact and convex multifunctions F ensures that the set of solutions of (0.18.1) is a nonempty and compact subset of PC and that the solution operator is u.s.c. with respect to the initial value a . The rather long proof uses a nonlinear alternative of Leray and Schauder type for multivalued operators, and a special measure of noncompactness. For the nonconvex case the authors prove two different results on the existence of at least one mild solution: first, they consider the case when F is l.s.c., and they use a combination of a selection theorem due to Bressan, Colombo and Fryszkowski with the nonlinear alternative of Leray and Schauder; second, they consider Carathéodory multifunctions satisfying a Hausdorff-Lipschitz condition and use a fixed point theorem for contractive multivalued operators.

The second part of *Chapter 3* is devoted to properties of the solution sets of (0.18.1) when F is a Carathodory multifunction which assumes compact and convex values. Specifically, the authors prove that the set of solutions is compact and contractible when F admits a measurable, locally Lipschitz selection, and that the set of solutions is compact and R_d -contractible when F has a Carathodory selection. By R_d -contractible, the authors mean a set which admits a multivalued u.s.c. homotopy with an R_d -set, and, in turn, an R_d -set is the intersection of a decreasing sequence of compact nonempty contractible metric spaces.

Chapter 4 contains more similar results for the periodic problem

$$\begin{cases} (y' - Ay)(t) \in F(t, y(t)), & \text{a.e. } t \in J \setminus \{t_1, \dots, t_m\}, \\ y(t_k^+) - y(t_k^-) = I_k(y(t_k^-)), & k = 1, \dots, m, \\ y(0) = y(b). \end{cases} \quad (0.18.2)$$

where A, F and the I_k 's are as in *Chapter 3*. Remember that A generates a semigroup $T(t)_{t \geq 0}$. The main difference with respect to the initial value problem (0.18.1) is that (0.18.2) cannot always be transformed in a fixed point problem. It can be when $1 \in (T(b))$, i.e., when 1 is a resolvent value for the operator $T(b)$, in the sense that the operator $I - T(b)$ is invertible (here I stands for the identity operator). When $1 \notin (T(b))$, then the authors use a Poincaré map approach and degree theory. The case $1 \in (T(b))$ is studied first by means of similar arguments to those in *Chapter 3* for initial value problems, but we also find in this case some extra information, namely, sharp results based on measures of noncompactness (as the authors put it, "the MNC approach"), continuous dependence of solutions on parameters and a Filippov-type theorem.

When $1 \notin (T(b))$, the authors use a Poincaré map approach along with an original nonlinear alternative for multimaps.

Chapter 5 contains a generalization of some of the previous results to initial value problems for functional differential inclusions of the form

$$(y' - Ay)(t) \in F(t, y_t),$$

where $y_t(\theta) = y(t + \theta)$ for all $\theta \in [-r, 0]$. This section contains no proof, and readers are referred to [S. Djebali, L. Grniewicz and A. Ouahab, *Topol. Methods Nonlinear Anal.* 32 (2008), no. 2, 261312; MR2494058 (2010a:34139)] for details.

In *Chapter 6* the authors study existence of solutions and properties of the solution sets for problems on the half-line of the following type:

$$\begin{cases} y'(t) \in F(t, y(t)), & \text{a. e. } t \in J := [0, \infty) \setminus \{t_1, t_2, \dots\}, \\ \Delta y|_{t=t_k} = I_k(y(t_k^-)), & k = 1, \dots, \\ y(0) = a, \end{cases} \quad (0.18.3)$$

where $F : [0, \infty) \times \mathbb{R}^n \rightarrow \mathcal{P}(\mathbb{R}^n)$. For the u.s.c. convex-valued case, and assuming some other technical conditions, the authors prove that the solution set of (0.18.3) is compact and depends upper semi-continuously on the initial value a . The nonconvex Lipschitz case is treated with a nonlinear alternative for multi-valued contractions due to Frigon, and

the nonconvex l.s.c. case with another nonlinear alternative and an adequate selection theorem for lower semi-continuous mappings with decomposable values. The authors provide us with further information on the topological structure of solution sets by means of a projective limit approach.

Finally, *Chapter 7* contains some interesting information which connects the results in the paper under review with lots of bibliographical references.

2. "Solution Sets for Differential Equations and Inclusions", (joint book with L. Górniewicz and A. Ouahab), "De Gruyter Series in Nonlinear Analysis and Applications, 18", Walter De Gruyter, Berlin, Germany, 2012, xix+453 pp. (appeared 14 November 2012) ISBN: 978-3-11-029356-2. DOI: 10.1515/9783110293562 <http://www.degruyter.com/view/product/184567>.

- *Zentrablatt Review by M. Sotiris K. Ntouyas (Ioannina, Greece).*

In this excellent book a comprehensive description of methods concerning the topological structure of fixed point sets and solution sets for differential equations and inclusions is presented. The book contains six chapters. Four main chapters and two supplementary chapters which contain the basic notions for a useful basis for the entire book. *Chapter 1* focused on the fundamental results recently obtained and which concern the topological structure of single-valued and multi-valued fixed point mappings. The case of nonexpansive maps is considered but also the structure of solution sets for multi-valued contractions is investigated. This abstract theory plays a key role in the investigation of solution sets of many initial and boundary value problems.

Chapter 2 contains most of the classical known results on the existence theory for Cauchy problems and boundary value problems for ordinary differential equations and inclusions. Such problems are considered on compact and noncompact intervals of the real line.

In *Chapter 3* some of the results obtained in *Chapter 1* are used in order to investigate the topological structure of solution sets for some initial and boundary value problems associated with differential equations and inclusions, extending the classical Kneser-Hukuhara theorems.

In *Chapter 4*, a detailed account of the existence theory together with the investigation of structure of solution sets of impulsive differential equations and inclusions is presented. This chapter is designed as a survey of some recent results obtained by the authors and others.

In *Chapter 5*, the authors present a concise review of the requisite mathematical background, such as, fundamental facts from geometric topology, homology theory related to the Vietoris mapping theorem and, finally, necessary information about the Lefschetz number is given.

Finally, in *Chapter 6*, the authors give an overview of basic notions of multivalued analysis.

An extensive Bibliography of 476 items (most of them recent) is given at the end of the book. The exposition is clear and almost self-contained. Several examples of applications relating to initial and boundary value problems are discussed in details. The book is intended to advanced graduate researchers interested in topological properties of fixed point sets and applications.

MSC 2000: 34-02 Research monographs (ordinary differential equations); 34G25 Evolution inclusions; 35A24

Keywords: differential inclusions; solution sets; impulsive differential equations and inclusions; fixed point theory

• *MathScinet Review by Rodrigo L. Pouso, Santiago del Compostela, Spain.*

This interesting and self-contained book offers both classical and recent results on the existence of solutions for differential equations and inclusions, and on the topological structure of solution sets. As the authors put it, "Our main motivation [is] twofold: first, to provide many of the basic techniques and results recently developed about this theory; second, to assemble the literature that is disseminated and scattered in several papers of pioneering researchers who developed the functional analytic framework of this field over the past few decades." Chapter one concerns the topological structure of fixed point sets and ranges from basic results (such as Banach's or Schauder's theorem) to advanced ones on acyclicity of solution sets, fixed points for multivalued maps leaning on measures of noncompactness, or the topological structure of fixed points of inverse limit mappings. Chapter two contains applications of the results in chapter one to existence theory for differential equations and inclusions. Chapter three studies the topological structure of solution sets, and chapter four is devoted to extending the results in chapters two and three to the impulsive case. Interested readers should also consult another book by the same authors [Existence and structure of solution sets for impulsive differential inclusions: a survey,

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