X Encontro Regional de Topologia

Caderno de resumos

22–24 de outubro de 2015

ICMC–USP, DM–UFSCar

São Carlos–SP

Programa

Quinta 22/10 - ICMC USP

19:00 – 19:30	Inscrição	
19:30 – 20:00	Abertura	
20:00 – 21:00	John Guaschi (Plenária)	pg. 5

Sexta 23/10 - UFSCar

09:00 – 10:00	Facundo (Plenária)	pg. 12
10:00 – 10:30	Letícia	pg. 06
10:30 – 11:15	Posters I & *Café*	pg. 16
11:15 – 11:45	Weslem	pg. 15
11:45 – 12:15	Dessislava	pg. 02
12:00 – 14:00	*Almoço*	
14:00 – 15:00	Mio (Plenária)	pg. 14
15:00 – 15:30	Dirceu	pg. 03
15:30 – 16:00	Oscar	pg. 10
16:00 – 17:00	Posters II & *Café*	pg. 16
17:00 – 17:30	Northon	pg. 09
17:30 – 18:30	Jean-Paul Brasselet (Plenária)	pg. 04

Sábado 24/10 - ICMC USP

09:00 – 09:30	Thiago	pg. 13
09:30 – 10:00	Thuy	pg. 08
10:00 – 10:30	Luciana	pg. 07
10:30 – 11:00	*Café*	
11:00 – 12:00	Peter Wong (Plenária)	pg. 11
12:00 – 12:30	Daciberg	pg. 01

Talks

Nielsen classes of non split n-valued maps 1
Daciberg Lima Gonçalves and John Guaschi

Growth of homology in finitely presented soluble groups 2
Dessislava Kochloukova

Reidemeister Classes for Coincidences Between Sections of a fiber bundle 3
D. Penteado and T.F.V. Paiva

Remarks on Cobordism of Maps on Locally Orientable Witt Spaces / A Lefschetz coincidence theorem for intersection homology 4
Jean-Paul Brasselet

Configuration spaces, braid groups and homotopy fibres 5
Daciberg Gonçalves and John Guaschi

Deformability by fibrewise homotopy over S^1 of pairs (f, g); $f, g : M(\phi_1) \to M(\phi_2)$ to a coincidence free pairs (f', g'), where $M(\phi_1)$ and $M(\phi_2)$ are fibre bundles over S^1 and the fibre is a torus 6
Letícia Sanches Silva and João Peres Vieira

On the index at an isolated singular point of principal foliations of surfaces in $\mathbb{R}^3$ 7
Luciana F. Martins and J.C.F. Costa and J.J. Nuno-Ballesteros

Um algoritmo para classificar o conjunto assintótico associado a uma aplicação polinomial 8
Nguyen Thi Bich Thuy

Special maps from surfaces to $S^2 \vee S^1$ 9
Northon Canevari Leme Penteado and Oziride Manzoli Neto

Center of braid groups quotients and the homotopy groups of the 2-sphere 10
Oscar Ocampo

Obstruction theory for coincidences of multiple maps 11
Thais Monis and Peter Wong

Persistent homology of finite metric spaces and its stability 12
Roberto Facundo Mémoli Techera

Generalized Whitehead product 13
Thiago de Melo and Marek Golasiński

Local persistent homology and barcode fields 14
Washington Mio

Nielsen number and one-parameter Lefschetz class of homotopies on torus 15
Weslem Liberato Silva

NIELSEN CLASSES OF NON SPLIT n-VALUED MAPS

DACIBERG LIMA GONÇALVES AND JOHN GUASCHI

We develop, using standard tecniques of fixed point theory and covering space, a proceure how to compute the Nielsen number of a n-valued map which is not split. We use coincidence theory for single values map to express our result. This will extend the known formula given by Helga Schirmer which says that for a split multivalued map the Nielsen number of a multivalued map $\varphi : X \multimap X$ is the sum of the Nielsen numbers of the coordinates. This might give some light how to undertand Reidemeister classes on the context of multivalued maps.

References

[1] Robert F. Brown, Fixed points of n-valued multimaps of the circle, *Bull. Pol. Acad. Sci. Math.* **54** no. 2 (2006), 153-162.

[2] Robert F. Brown, The Lefschetz number of an n-valued multimap, *JP J. Fixed Point Theory Appl.* **2** no. 1 (2007), 53-60.

[3] Robert F. Brown, Nielsen numbers of n-valued fiber maps, *J. Fixed Point Theory Appl.* **4** no. 2 (2008), 183-201.

[4] Robert F. Brown, Jon T. Lo Kim Lin, Coincidences of projections and linear n-valued maps of tori, *Topology Appl.* **157** no. 12 (2010), 1990-1998.

[5] H. Schirmer, An index and a Nielsen number for $n-$valued multifunctions, *Fund. Math.* **124** (1984), 207–219.

[6] H. Schirmer, A minimum theorem for $n-$valued multifunctions, *Fund. Math.* **126** (1985), 83–92.

(Daciberg Lima Goncalves) Department of Mathematics, IME-University of São Paulo
E-mail address: dlgoncal@ime.usp.br

(John Guaschi) Laboratoire de Mathématiques Nicolas Oresme UMR CNRS-Université de Caen
E-mail address: guaschi@math.unicaen.fr

GROWTH OF HOMOLOGY IN FINITELY PRESENTED SOLUBLE GROUPS

DESSISLAVA KOCHLOUKOVA

We discuss the growth of homology of subgroups of finite index in finitely presented soluble groups. I will discuss joint results with M. Bridson and F. Mokari.

(Dessislava Kochloukova) UNICAMP
E-mail address: desi@ime.unicamp.br

REIDEMEISTER CLASSES FOR COINCIDENCES BETWEEN SECTIONS OF A FIBER BUNDLE

D. PENTEADO AND T.F.V. PAIVA

Let s_0, f_0 be two sections of a fiber bundle $q : E \to B$ and $\Gamma(s_0, f_0)$ the coincidence set point. We consider the following question: Is $s_0 \simeq_B s_1$ or $f_0 \simeq_B f_1$ (homotopies over B) such that $\Gamma(f_0, s_1)$ or $\Gamma(s_0, f_1) = \emptyset$? This situation is motivated by the fixed point theory. Specifically: given $f : B \to B$, we consider the fiber bundle $q : B \times B \to B$ and the sections $s_0, f_0 : B \to B \times B$ given by $s_0(b) = (b, b)$ and $f_0(b) = (b, f(b))$. We can supposed that $b_0 \in \Gamma(s_0, f_0)$ and we also denoted by $s_0, f_0 : \pi_1(B, b_0) \to \pi_1(E, e_0)$ where $e_0 = f_0(b_0) = s_0(b_0)$ and $F_0 = q^{-1}(b_0)$ the typical fiber. So we have $\pi_1(E, e_0) \simeq \pi_1(F_0, e_0) \rtimes \pi_1(B, b_0)$. We defined the Reidemeister equivalence classes relative to the subgroup $\pi_1(F_0, e_0)$: we said that $\gamma_1, \gamma_2 \in \pi_1(F_0, e_0)$ are Reidemeister related if there is $\beta \in \pi_1(B, b_0)$ such that $s_0(\beta) * \gamma_1 = \gamma_2 * f_0(\beta)$. We denoted by $[\gamma_1]_A \in R(s_0, f_0; \pi_1(F_0, e_0))$ the class of γ_1. We constructed the covering spaces from the normal subgroups $[\overline{b}_0] \lhd \pi_1(B, b_0)$ $[\overline{e}_0] \lhd \pi_1(E, e_0)$ and $\pi_1(F_0, e_0) \lhd \pi_1(E, e_0)$, namely: $p^{b_0} : \widetilde{B}(b_0) \to B$, $p^{e_0} : \widetilde{E}(e_0) \to E$ and $p^{F_0} : \widetilde{E}(F_0) \to E$ so $p^{e_0} = p^{F_0} \circ p^{e_0}_{F_0}$, where $p^{e_0}_{F_0} : \widetilde{E}(e_0) \to \widetilde{E}(F_0)$. From this, we explicit the lifting maps $\tilde{s}_0, \tilde{f}_0 : \widetilde{B}(b_0) \to \widetilde{E}(e_0)$ and $s_{F_0}, f_{F_0} : \widetilde{B}(b_0) \to \widetilde{E}(F_0)$. In the set $\mathcal{L}(s_0; f_{F_0})$ of lifting $\tilde{s} : \widetilde{B}(b_0) \to \widetilde{E}(e_0)$ of the section s_0 such that $f_{F_0} = p^{e_0}_{F_0} \circ \tilde{s}$, we defined the equivalence relation R_L. We denoted by $[\tilde{s}]_L \in R_L(\mathcal{L}(s_0; f_{F_0}))$ the class of $\tilde{s}$ by the relation R_L. Now we obtained the theorem as in [Ji-83] :

Let $\Gamma^{\widetilde{B}(b_0)}_{\widetilde{E}(e_0)}(\tilde{f}_0, \tilde{s}_1)$ and $\Gamma^{\widetilde{B}(b_0)}_{\widetilde{E}(e_0)}(\tilde{f}_0, \tilde{s}_2)$ be the coincidence sets for $\tilde{s}_1, \tilde{s}_2 \in \mathcal{L}(s_0; f_{F_0})$.

(i) There is a one to one correspondence $\Psi : R_L(\mathcal{L}(s_0; f_{F_0})) \to R_A(f_0, s_0; \pi_1(F_0, e_0))$.

(ii) If $[\tilde{s}_1]_L = [\tilde{s}_2]_L$ then $p^{b_0}\left(\Gamma^{\widetilde{B}(b_0)}_{\widetilde{E}(e_0)}(\tilde{f}_0, \tilde{s}_1)\right) = p^{b_0}\left(\Gamma^{\widetilde{B}(b_0)}_{\widetilde{E}(e_0)}(\tilde{f}_0, \tilde{s}_2)\right)$.

(iii) If $p^{b_0}\left(\Gamma^{\widetilde{B}(b_0)}_{\widetilde{E}(e_0)}(\tilde{f}_0, \tilde{s}_1)\right) \cap p^{b_0}\left(\Gamma^{\widetilde{B}(b_0)}_{\widetilde{E}(e_0)}(\tilde{f}_0, \tilde{s}_2)\right) \neq \emptyset$ then $[\tilde{s}_1]_L = [\tilde{s}_2]_L$.

(iv) If $[\tilde{s}_1]_L \neq [\tilde{s}_2]_L$ then $p^{b_0}\left(\Gamma^{\widetilde{B}(b_0)}_{\widetilde{E}(e_0)}(\tilde{f}_0, \tilde{s}_1)\right) \cap p^{b_0}\left(\Gamma^{\widetilde{B}(b_0)}_{\widetilde{E}(e_0)}(\tilde{f}_0, \tilde{s}_2)\right) = \emptyset$.

References

[Je-96] JEZIERSKI, J., **The Relative Coincidence Nielsen Number.** Fundamenta Mathematicae, 149 (1996), No. 1, pp. 01-18.

[Ji-83] JIANG, B., **Lectures on Nielsen Fixed Point Theory**. Contemp. Math., vol. 14: American Mathematical Soc., 1983.

[L-B-98] LEE, S. H., & BAEK, S., **Remarks on the Reidemeister Number for Coincidences.** Comm. Korean Math. Soc. 13 (1998), No. 1, pp. 109-121.

[Ro-88] ROTMAN, J. J., **An Introduction to Algebraic Topology.** New York: Spring-Verlag, 1988.

[Sta-11] STAECKER, C. P., **Nielsen Equalizer Theory.** Topology and its Applications, 158 (2011), No. 13, pp. 1615-1625.

(Dirceu Penteado) Departamento de Matemática, Universidade Federal de São Carlos, Rodovia Washington Luiz, Km 235, São Carlos 13565-905, Brazil

E-mail address: dirceu@dm.ufscar.br

(Thales Fernando Vilamaior Paiva) Departamento de Matemática, Universidade Federal de Mato Grosso do Sul, CPAq, Brazil

E-mail address: thales.paiva@ufms.br

(1) REMARKS ON COBORDISM OF MAPS ON LOCALLY ORIENTABLE WITT SPACES (2) A LEFSCHETZ COINCIDENCE THEOREM FOR INTERSECTION HOMOLOGY

JEAN-PAUL BRASSELET, ALICE K. M. LIBARDI, THAIS F. MENDES MONIS, ELIRIS C. RIZZIOLLI AND MARCELO SAIA

Remarks on Cobordism of Maps on Locally Orientable Witt Spaces

Aim of this work is to present some remarks on cobordism of normally non-singular maps between locally orientable Witt spaces. By using the Wu classes defined by Goresky and Pardon we give also a definition of Stiefel–Whitney numbers in this situation. Following Stong's construction, we construct a map in the respective intersection homology groups and we show in several cases that null-cobordism implies the vanishing of these Stiefel–Whitney numbers.

A Lefschetz coincidence theorem for intersection homology

Goresky and MacPherson proved the Lefschetz fixed point theorem in the context of a class of "placid" self maps f of singular spaces X, by using intersection homology. In fact they showed that both the graph of f and the diagonal carry fundamental classes in the intersection homology of $X \times X$, and that the Lefschetz number $IL(f)$ is the intersection number of these two classes. This result leads us naturally to the question of coincidence. Our main goal is to explicit the formula of the Lefschetz coincidence number for placid maps $f, g : X \to Y$ between oriented compact $\mathbb{Q}$-Witt spaces of same dimension and prove the Lefschetz coincidence theorem in this setting.

(Jean-Paul Brasselet) Institut de Mathématiques de Marseille
E-mail address: jean-paul.brasselet@univ-amu.fr

CONFIGURATION SPACES, BRAID GROUPS AND HOMOTOPY FIBRES

DACIBERG GONÇALVES AND JOHN GUASCHI

Let M be a surface. In order to understand better the nth configuration space $F_n(M)$ of M (whose fundamental group is the n-string pure braid group $P_n(M)$ of M), we may compare it with the n-fold Cartesian product M^n of M with itself by studing their homotopy type, the inclusion $\iota\colon F_n(M) \longrightarrow M^n$, and the induced homomorphism $\iota_{\#}\colon P_n(M) \longrightarrow (\pi_1(M))^n$. One way to analyse this homomorphism (as well as those induced on the higher homotopy groups) is to determine the homotopy fibre I_ι of ι. In this talk, we discuss a conjecture of Birman regarding $\ker(\iota_{\#})$ and prove it in the outstanding case where $M = \mathbb{R}P^2$. We then compute the homotopy fibre of ι when $M = \mathbb{S}^2$ or $\mathbb{R}P^2$, and from this we obtain various exact sequences involving the homotopy groups of $F_n(M)$ and $\mathbb{S}^2$. In the case of $\mathbb{R}P^2$, the proofs bring into play the notion of orbit configuration spaces introduced by F. Cohen and M. Xicoténcatl.

(Daciberg Gonçalves) IME-USP
E-mail address: `dlgoncal@ime.usp.br`

(John Guaschi) Laboratoire de Mathématiques Nicolas Oresme UMR 6139, Université de Caen Normandie, France
E-mail address: `john.guaschi@unicaen.fr`

DEFORMABILITY BY FIBREWISE HOMOTOPY OVER S^1 OF PAIRS (f,g); $f,g : M(\phi_1) \to M(\phi_2)$ TO A COINCIDENCE FREE PAIRS (f',g'), WHERE $M(\phi_1)$ AND $M(\phi_2)$ ARE FIBRE BUNDLES OVER S^1 AND THE FIBRE IS A TORUS

LETÍCIA SANCHES SILVA AND JOÃO PERES VIEIRA

Let $M(\phi_1)$ and $M(\phi_2)$ be fibre bundles over the circle S^1 and the fibre is the torus T and $f,g : M(\phi_1) \to M(\phi_2)$ fibre preserving maps over S^1. In this work we investigate if the pair (f,g) can be deformed, by a fibrewise homotopy over S^1, to a coincidence free pair (f',g'). In general classify such pairs of maps consists in finding solutions for an equation in the free group $\pi_2(T, T-1)$, called the main equation. In certain situations find these solutions is not an easy task and moreover in the cases where it is not possible to obtain the desired deformability we have that this equation has no solution. Thus, it is appropriate to study the main equation in the abelianization of $\pi_2(T, T-1)$ and on some quotients of this group, since if the equation in one of these quotients not admit solution we can infer that the original equation also does not admit solution.

References

[1] Brooks, R. *Coincidences, roots and fixed points*, Doctoral Dissertation, University of California, Los Angeles, **1967**.

[2] Fadell, E. and Husseini S. *A fixed point theory for fiber-preserving maps*, Lecture Notes in Mathematics, vol. **886**, Springer,49–72, **1981**.

[3] Gonçalves, D. L., Penteado, D. and Vieira, J. P. *Fixed Points on Torus Fiber Bundles over the Circle*, Fundamenta Mathematicae, vol.**183**(1), 1–38, **2004**.

[4] Vieira, J. P. *Coincidence of maps on Torus fibre bundles over the circle* , Topological Methods in Nonlinear Analysis, **2015** (to appear).

(Letícia Sanches Silva) Aluna de Doutorado em Matemática-UNESP/IBILCE-SJRP
E-mail address: `leticiasanchessilva@gmail.com`

(Dep. Matemática -UNESP/IGCE-Rio Claro)
E-mail address: `jpvieira@rc.unesp.br`

ON THE INDEX AT AN ISOLATED SINGULAR POINT OF PRINCIPAL FOLIATIONS OF SURFACES IN $\mathbb{R}^3$

LUCIANA F. MARTINS, J.C.F. COSTA, AND J.J. NUNO-BALLESTEROS

We study the index of an isolated singular point of the binary differential equation which represents the equation of the principal directions of a corank 1 map germ $f : (\mathbb{R}^2, 0) \to (\mathbb{R}^3, 0)$. We suppose that f or is a simple map germ either is a map germ of codimension less or equal to 3. We show that the index, under certain condition, is always 0 or 1.

(Luciana F. Martins) IBILCE-UNESP-São José do Rio Preto
E-mail address: lmartins@ibilce.unesp.br

(J.C.F. Costa) IBILCE-UNESP-São José do Rio Preto
E-mail address: jcosta@ibilce.unesp.br

(J.J. Nuno-Ballesteros) Universidade de Valência
E-mail address: Juan.Nuno@uv.es

UM ALGORITMO PARA CLASSIFICAR O CONJUNTO ASSINTÓTICO ASSOCIADO A UMA APLICAÇÃO POLINOMIAL

NGUYEN THI BICH THUY

Nós demos um algoritmo para classificar o conjunto assintótico associado a uma aplicação polinomial dominante $F : \mathbb{C}^n \to \mathbb{C}^n$.

(Nguyen Thi Bich Thuy) IBILCE - UNESP
E-mail address: `bichthuy@ibilce.unesp.br`

SPECIAL MAPS FROM SURFACES TO $S^2 \vee S^1$

NORTHON CANEVARI LEME PENTEADO AND OZIRIDE MANZOLI NETO

In this work we are interested in describing a certain special type of element in each homotopy class of the set $[S; S^2 \vee S^1] = \{[f]; f : S \to S^2 \vee S^1$ is continuous$\}$, where S is some closed connected orientable surface. We associate to each homotopy class $[f]$ a polynomial in $\mathbb{Z}[\mathbb{Z}]$, and that polynomial characterize a special map. This special representative has good properties and realize a certain minimal set of roots for all points in $S^2 \vee S^1$.

References

[1] Aniz, C., *Raízes de funções de um complexo em uma variedade*, tese de doutorado do ICMC-USP, **2002**.
[2] Borsari, L. D., Gonalves, D. L., *The First Group (Co)Homology of a Group G with Coefficients in Some G-Modules* Quaest. Math., **31**, **2008**, 89-100.
[3] Brooks, R., *Roots of mappings from manifolds*, Fixed Point Theory Appl., **4**, **2004**, 273-307.
[4] Fenille, M. C., *Raízes de aplicações de complexos 2-dimensionais em superfícies fechadas*, tese de doutorado do ICMC-USP, **2009**.
[5] Jackson, J. R., *Spaces of mappings on topological products with applications to homotopy theory*, Proc. Amer. Math. Soc., **3**, **1952**, 327-333.
[6] Davis, J. F., Kirk, P., *Lectures Notes in Algebraic Topology*, American Mathematical Society, 55-XX, **1991**.
[7] Pajitnov, A. *Circle-valued Morse Theory*, Walter de Gruyter **32**, **2006**.
[8] Penteado, N. C. L., Manzoli N., O. *Representing homotopy classes by maps with certain minimality root properties*, The Royal Society of Edinburgh Proceedings A (Mathematics), to appear.
[9] Spanier, E. H., *Algebraic Topology*, Springer-Verlag Berlin Heidelberg New York, **1966**.
[10] Switzer, R. M., *Algebraic Topology- Homotopy and Homology*, Springer-Verlag Berlin Heidelberg New York, **1975**.
[11] Whitehead, G. W., *Elements of Homotopy Theory*, Springer-Verlag Berlin Heidelberg New York, **1978**.

Instituto de Geocincias e Cincias Exatas-UNESP
E-mail address: northoncanevari@gmail.com

Instituto de Cincias Matemticas e Computao-USP
E-mail address: ozimneto@icmc.usp.br

CENTER OF BRAID GROUPS QUOTIENTS AND THE HOMOTOPY GROUPS OF THE 2-SPHERE

OSCAR OCAMPO

One of the fundamental problems in algebraic topology is to study the homotopy groups of spheres, and in general they are unknown. Let $P_n(M)$ denote the pure braid group with n strings over a surface M. Let $Z(G)$ denote the center of a given group G. In this work we will show that, for $n \geq 3$ and M being the disk D^2 or the 2-sphere S^2, there exists a normal subgroup $G_n(M)$ of $P_n(M)$ such that

$$Z\left(\frac{P_n(D^2)}{G_n(D^2)}\right) \cong \pi_n(S^2) \times \mathbb{Z}$$

and

$$Z\left(\frac{P_{n+1}(S^2)}{G_{n+1}(S^2)}\right) \cong \pi_n(S^2) \times \mathbb{Z}_2.$$

The group $G_n(M)$ can be explicitly described by iterated commutators using the standard Artin generators for pure braids.

For $M = D^2$ this result is due to J.Y.Li and J.Wu [Proc. London Math. Soc. - 2009], however we give a different proof for this case. The case $M = S^2$ is new. Moreover, this type of result may be extended to any surface.

(Oscar Ocampo) Universidade Federal da Bahia
E-mail address: oscaro@ufba.br

OBSTRUCTION THEORY FOR COINCIDENCES OF MULTIPLE MAPS

THAIS MONIS AND PETER WONG

Let $f_1, ..., f_k : X \to N$ be maps between two manifolds X, N where $k \geq 3$. In [1], the authors introduced, for orientable N, a Lefschetz type coincidence class $L(f_1, ..., f_k)$ which has been recently generalized in [5] for N non-orientable. In this work, we study the converse problem, that is, the problem whether $f_1, ..., f_k$ are deformable to be coincidence free when $L(f_1, ..., f_k) = 0$. We further generalize the notion of the Lefschetz class of [5] using [4] and obtain the converse under some conditions on N using obstruction theory and the work of [3] and [2].

References

[1] C. Biasi, A. Libardi and T. Monis, The Lefschetz coincidence class of p-maps, *Forum Math.*, **27**(2015), 1717–1728 (DOI 10.1515/forum-2013-0038 online May 2013).

[2] R. Dobrenko, The obstruction to the deformation of a map out of a subspace. *Dissertationes Math. (Rozprawy Mat.)* **295** (1990), 29 pp.

[3] E. Fadell and S. Husseini, Fixed point theory for non simply connected manifolds, *Topology* **20** (1981), 53–92.

[4] D. Gonçalves and P. Wong, Cohomology of preimages with local coefficients, *Algebr. Geom. Topol.* **6** (2006), 1471–1489.

[5] T. Monis and S. Spiez, Lefschetz coincidence class for several maps, *J. Fixed Point Theory Appl.*, to appear.

(Thais Monis) UNESP-Rio Claro
E-mail address: tfmonis@rc.unesp.br

(Peter Wong) Bates College
E-mail address: pwong@bates.edu

PERSISTENT HOMOLOGY OF FINITE METRIC SPACES AND ITS STABILITY

ROBERTO FACUNDO MÉMOLI TECHERA

Given a finite metric space (X, dX) for each non negative real number t it is possible to give rise to a simplicial complex, called the Vietoris–Rips simplicial complex $R_t(X)$, with the property that for s greater than t, $R_t(X)$ is a subcomplex of $R_s(X)$. If $0 = t_0 < t_1 < t_2 < \cdots < t_k$ denote the set of values realized by the distance function dX, then one obtains a directed system of simplicial complexes and simplicial maps

$$R_{t_0}(X) \to R_{t_1}(X) \to \cdots \to R_{t_k}(X)$$

When one applies the homology functor (with field coefficients) to the above diagram one obtains a directed system of vector spaces and linear maps. This system admits a classification up to isomorphism in terms of finite collections of intervals, called barcodes. We'll discuss the stability of these barcodes in terms of the Gromov–Hausdorff distance.

(Roberto Facundo Mémoli Techera) OHIO UNIVERSITY - USA
E-mail address: `facundo.memoli@gmail.com`

GENERALIZED WHITEHEAD PRODUCT

THIAGO DE MELO AND MAREK GOLASIŃSKI

In this talk we introduce the basic concepts on higher order Whitehead product for maps $f_i : \Sigma A_i \to X$, $i = 1, \ldots, r$. Also we present some computations for the triple spherical product to show that $[\eta_4, \eta_4^2, 2\iota_4]$ is trivial.

(Thiago de Melo) IGCE–Unesp Rio Claro
E-mail address: tmelo@rc.unesp.br

(Marek Golasiński) Institute of Mathematics Casimir the Great University, Poland
E-mail address: marek@ukw.edu.pl

LOCAL PERSISTENT HOMOLOGY AND BARCODE FIELDS

WASHINGTON MIO

(to be announced)

(Washington Mio) Florida State University - USA
E-mail address: mio@math.fsu.edu

NIELSEN NUMBER AND ONE-PARAMETER LEFSCHETZ CLASS OF HOMOTOPIES ON TORUS

WESLEM LIBERATO SILVA

Let $F : T \times I \to T$ be a homotopy on torus and $G = \pi_1(T, x_0)$. R.Geoghegan and A. Nicas in [1] developed an one-parameter theory and defined the one-parameter trace $R(F)$ of F. The element $R(F)$ is a 1-chain in $HH_1(\mathbb{Z}G, (\mathbb{Z}G)^{\phi})$). This 1-chain gives information about the fixed points of F, that is, using $R(F)$ is possible to define the one-parameter Nielsen number $N(F)$ of F and the one-parameter Lefschetz class $L(F)$. N(F) is the number of non-zero C-components in $R(F)$ and $L(F)$ is the image of $R(F)$ in $H_1(G)$ by homomorfism $\bar{j_C} : H_1(Z(g_C)) \to H_1(G)$, induced by inclusion $j_C : Z(g_C) \to G$, where $Z(g_C)$ is the semicentralizer of an element g_C which represents the semiconjugacy class C. The precise definition is given in [1]. In this work we will show that for each homotopy on torus $N(F)$ and $L(F)$ are related by;

$$L(F) = \pm N(F)\alpha$$

where α is one of the two generators of $H_1(G, \mathbb{Z})$. The calculation of $N(F)$ for some homotopies on torus can be found in [2].

References

[1] R. Geoghegan and A. Nicas, *Parametrized Lefschetz-Nielsen fixed point theory and Hochschild homology traces*, Amer. J. Math. 116, 397-446, **1994**.

[2] W. L. Silva, *Minimal fixed point set of fiber-preserving maps on T-bundles over S^1*, Topology and its Applications, 173, 240-263, **2014**.

(Weslem) Universidade Estadual de Santa Cruz
E-mail address: wlsilva@uesc.br

Posters I & II

A Proof of The Universal Coefficient Theorem for Homology Groups 17
Bruno Caldeira Carlotti de Souza and Maria Gorete Carreira Andrade

On topological version of the Tverberg theorem 18
Carlos H. F. Poncio and Edivaldo L. dos Santos

Configuration spaces 19
César Zapata and Denise de Mattos

The universal space theorem for dimension 0 20
Givanildo Donizeti de Melo and Thais Fernanda Mendes Monis

On Gottlieb groups 21
Guilherme Vituri Fernandes Pinto and Thiago de Melo

An obstruction for virtual duality groups 22
Jessica Cristina Rossinati Rodrigues da Costa and Maria Gorete Carreira Andrade

The Artin presentation theorem 23
Letícia Melocro and Denise de Mattos

Calculating the singular homology groups of some spaces 24
Rodrigo dos Santos Bononi and Erminia de L. Campello Fanti

Equisingularity of map germs from $\mathbb{C}^4,0$ *to* $\mathbb{C}^3,0$ 25
A. J. Miranda and M. J. Saia and E. C. Rizziolli and V. H. Jorge-Pérez

Some example of involution fixing $\mathbb{R}P^j \cup \mathbb{C}P^k$ *with* j *and* k *even* 26
Amanda Ferreira de Lima and Pedro Luiz Queiroz Pergher

Strong surjectivity of mappings of some 3*-complexes with two* 3*-cells into* $M_{Q_{16}}$ 27
Claudemir Aniz

On the Discriminants of map germs from $\mathbb{C}^{n+1}$ *to* $\mathbb{C}^n$, $n = 3, 4$ 28
Eliris Cristina Rizziolli

On roots for maps going from $\mathbb{R}P(3)$ *to* S^2 29
Gustavo de Lima Prado

Borsuk–Ulam and Bourgin–Yang theorems for mod p*-cohomology spheres* 30
Nelson A. Silva and Denise de Mattos and Edivaldo L. dos Santos

Dichotomy between density foliations and suspensions for Anosov actions 31
Rodrigo Ribeiro Lopes and Carlos Alberto Maquera Apaza

(H, G)*-Coincidence theorems for manifolds* 32
Taciana O. Souza and Denise de Mattos

A PROOF OF THE UNIVERSAL COEFFICIENT THEOREM FOR HOMOLOGY GROUPS

BRUNO CALDEIRA CARLOTTI DE SOUZA MARIA GORETE CARREIRA ANDRADE

In this work we present, based in [3], a construction of the homology group of a pair (X, A) of topological spaces with coefficients in an arbitrary abelian group G, denoted by $H_*(X, A; G)$, which is a natural generalization of the relative homology groups $H_*(X, A)$. Also based in [3], we present a proof of "The Universal Coefficient Theorem" for homology groups, which connect those two concepts, and some computations of homology groups of surfaces.

References

[1] Massey, W. S.; *A Basic Course in Algebraic Topology*, Springer-Verlag, **1991**.
[2] Munkres, J. R.; *Elements of Algebraic Topology*, Addison-Wesley, **1984**.
[3] Vick, J. W.; *Homology Theory: An Introduction to Algebraic Topology*, Springer-Verlag, **1973**.

(Bruno Caldeira Carlotti de Souza) Master Student supported by CAPES - Ibilce - UNESP - São José do Rio Preto - SP
E-mail address: brunoccarlotti@gmail.com

(Maria Gorete Carreira Andrade) Advisor - Ibilce - UNESP - São José do Rio Preto - SP
E-mail address: gorete@ibilce.unesp.br

ON TOPOLOGICAL VERSION OF THE TVERBERG THEOREM

CARLOS H. F. PONCIO AND EDIVALDO L. DOS SANTOS

Helge Tverberg showed that any set of $(d+1)(q-1)+1$ points in $\mathbb{R}^d$ admits a partition into q subsets such that the intersection of their convex hulls is non-empty. Such partitions are called Tverberg partitions; the result is the best possible: for less than $(d+1)(q-1)+1$ points in $\mathbb{R}^d$ the implication of the statement does not hold. In this work, we will use topological methods in combinatorics and geometry to prove a topological version of Tverberg theorem and a result about many Tverberg partitions.

References

[1] Brny,I., Shlosman, S.B., Szcs, A. *On a topological generalization of a theorem of Tverberg,* J. London Math. Soc., II. Ser. 23 (1981) 158-164.

[2] Crabb, M. C.*The topological Tverberg theorem and related topics.* J. Fixed Point Theory Appl. 12 (2012), no. 1-2, 1-25.

[3] Stephan, H. *On the number of Tverberg partitions in the prime power case.* European J. Combin. 28 (2007), no. 1, 347-355.

[4] Matoušek, J. it Using the Borsuk-Ulam Theorem. Lectures on Topological Methods in Combinatorics and Geometry, in: Universitext, Springer-Verlag, Heidelberg, 2003.

[5] Sarkaria, K. S. *Tverberg's theorem via number fields.* Israel J. Math. 79 (1992), no. 2-3, 317-320.

[6] Sarkaria, K.S. *Tverberg partitions and Borsuk-Ulam theorems*, Pacific J. Math. 196 (2000) 231-241.

[7] Tverberg, H., *A generalization of Radon's Theorem,* J. London Math. Soc. 41 (1966) 123-128.

[8] Volovikov, A. Y., *On a topological generalization of the Tverberg theorem*, Math. Notes 3 (1996) 324-326.

(Carlos H. F. Poncio) DM-UFSCar
E-mail address: carlosponcio@dm.ufscar.br

(Edivaldo L. dos Santos) DM-UFSCar
E-mail address: edivaldo@dm.ufscar.br

CONFIGURATION SPACES

CÉSAR ZAPATA AND DENISE DE MATTOS

Abstract. The purpose of this work is to introduce the theory of configuration spaces, some classical and new results in this field [1] ,[2] . It will also address the numerous applications of these results in real life [3], [4]. Configuration spaces are useful for addressing questions about collisions and linking starting with the archetypal Borsuk-Ulam theorem [5].

Let X be a space. The *configuration space* of ordered $k-$tuplas of distinct points in the space X is given by

$$Conf(X,k) := \{(x_1, \cdots, x_k) \in X^k : x_i \neq x_j \quad \textbf{if } i \neq j\}.$$

The symmetric group on $k-$letters $\sum_k$ acts naturally on $Conf(X,k)$ by permutation coordinates. The orbit space

$$\frac{Conf(X,k)}{\sum_k}$$

is *the unordered configuration space.*

As a example, in [6] the authors study the configuration space $Conf(X,k)$ of $k-$distinct points in a smooth compact $m-$manifold X, possibly with boundary. The paper determines the additive structure of the homology $H_\star(Conf(X,k);\mathbb{F})$ where $\mathbb{F}$ is any field if m is odd, and $\mathbb{F}_2$ otherwise.

References

[1] Frederick R. Cohen, *Introduction to configuration spaces and their applications*, Braids, Lect. Notes Ser. Inst. Math. Sci. Natl. Univ. Singap., vol. 19, World Sci. Publ., Hackensack, NJ, **2010**, pp. 183-261.
[2] Fadell, Edward R.; Husseini, Sufian Y. *Geometry and topology of configuration spaces.* Springer Monographs in Mathematics. Springer-Verlag, Berlin, **2001**.
[3] J.-C. Latombe, *Robot Motion Planning* , Kluwer Academic Press, Boston, MA, **1991**
[4] M. Farber, *Topological complexity of motion planning* , Discrete Comput. Geom. 29 (**2003**), 211-221.
[5] Fred Cohen and Ewing L. Lusk. *Configuration-Like Spaces and the Borsuk-Ulam Theorem*, Proceedings of the American Mathematical Society, Vol. 56, No. 1 (Apr., **1976**), pp. 313-317.
[6] C-F Bdigheimer, FR Cohen, L Taylor, *On the homology of configuration spaces*, Topology 28(**1989**) 111-123.

(César A. I. Zapata (student)) Deparatmento de Matemática,UNIVERSIDADE DE SÃO PAULO INSTITUTO DE CIÊNCIAS MATEMÁTICAS E DE COMPUTAÇÃO - USP , Avenida Trabalhador São-carlense, 400 - Centro CEP: 13566-590 - São Carlos - SP, Brasil
E-mail address: cesarzapata@usp.br

(Denise de Mattos) Deparatmento de Matemática,UNIVERSIDADE DE SÃO PAULO INSTITUTO DE CIÊNCIAS MATEMÁTICAS E DE COMPUTAÇÃO - USP , Avenida Trabalhador São-carlense, 400 - Centro CEP: 13566-590 - São Carlos - SP, Brasil
E-mail address: deniseml@icmc.usp.br

THE UNIVERSAL SPACE THEOREM FOR DIMENSION 0

GIVANILDO DONIZETI DE MELO AND THAIS FERNANDA MENDES MONIS

In topological dimension theory there are three different definitions of dimension: the small inductive dimension, the large inductive dimension and the covering dimension. The three dimension functions coincide in the class of separable metric spaces. In this work, we will consider the small inductive dimension for separable metric spaces and the goal is to prove the universal space theorem for dimension 0: the Cantor set and the space of irrational numbers are universal spaces for the class of all zero dimensional separable metric spaces. This result was established by W. Sierpiński im 1921.

References

[1] Engelking, R. *Dimension Theory*, PWN-Polish Scientific Publishers-Warszawa, **1978**.

(Givanildo) UNESP
E-mail address: givadonimelo@hotmail.com

(Thais) UNESP
E-mail address: tfmonis@rc.unesp.br

ON GOTTLIEB GROUPS

GUILHERME VITURI FERNANDES PINTO AND THIAGO DE MELO

In this work we study the Gottlieb group $G(X, x_0)$, which is a subgroup of $\pi_1(X, x_0)$, for a CW-complex X.

We present some elementary results, for example, we show that $G(X, x_0) = \pi_1(X, x_0)$ if X is a H-space. Also, we compute $G(P^{2n})$ for $n \geq 1$ and $G(T)$ for T a wedge of k circles, with $k > 1$.

Finally, we follow Varadarajan and generalize $G(X, x_0)$ as a subgroup of $[A, X]$ where A is a co-H-space.

References

[1] Gottlieb, D. H. *A certain subgroup of the fundamental group*, American J. Math. **87**, 840-856, 1965.

[2] Varadarajan, K. *Generalised Gottlieb groups*, Journal of Indian Math. Soc. **33**, 141-164, 1969.

(Guilherme Vituri Fernandes Pinto) PPGMAT-IBILCE, Unesp São José do Rio Preto
E-mail address: `vituri_vituri@hotmail.com`

(Thiago de Melo) Unesp Rio Claro
E-mail address: `tmelo@rc.unesp.br`

AN OBSTRUCTION FOR VIRTUAL DUALITY GROUPS

JESSICA CRISTINA ROSSINATI RODRIGUES DA COSTA AND MARIA GORETE CARREIRA ANDRADE

The cohomology group theory arose from studies in topology and algebra. In the mid-1940's a purely algebraic definition of group homology and cohomology, from which it became clear that the subject was of interest to algebraists as well as topologists, offered a great possibilities for interaction between areas. One such possibility is duality groups theory due Bieri and Eckmann([2]). The main theme of this work is the study Farrell's cohomology theory. In [1], Farrell extend Tate's cohomology theory for finite groups to a certain class of infinite groups: for groups of virtually finite cohomological dimension. Besides, through Farrell cohomology, will be present an obstruction for virtual duality groups satisfying the duality isomorphism of the theory due to Bieri and Eckmann.

References

[1] Farrell, F. T.*An extension of Tate cohomology to a class of infinite groups*, Journal of Pure and Applied Math. 10, 153-161 **1977**.

[2] Bieri, R., Eckmann, B. *Groups with homological duality generalizing Poincar duality.*, Invent.Math.20, 103-124 **1973**.

(Jessica Cristina Rossinati Rodrigues da Costa) Mestranda em Matemática - Bolsista FAPESP - IBILCE - UNESP - São José do Rio Preto - SP

E-mail address: `jessica.rossinati@gmail.com`

(Maria Gorete Carreira Andrade) Orientadora - IBILCE - UNESP - São José do Rio Preto - SP

E-mail address: `gorete@ibilce.unesp.br`

THE ARTIN PRESENTATION THEOREM

LETÍCIA MELOCRO (STUDENT) AND DENISE DE MATTOS (ADVISOR)

Braid groups first appeared, although in a disguised form, in an article by Adolf Hurwitz published in 1891 and devoted to ramified coverings of surfaces. The notion of a braid was explicitly introduced by Emil Artin in the 1920's to formalize topological objects that model the intertwining of several strings in the Euclidean 3-space. Artin pointed out that braids with a fixed number n of strings form a group, called the *Artin braid group of braids on n-strands*, denoted by $B(n)$. Since this early result, the theory of braids and the braid groups have been extensively studied by topologists and algebraists. This has led to a rich theory with numerous ramifications.

The main objetive of this work is to present a geometric description of the braid groups of the disk and show that the group $B(n)$ admits a presentation in terms of generators and relations in the famous theorem of Artin presentation. Emil Artin, in the 1920's, pointed out that braids with a fixed number n of strings form a group, called the *Artin braid group of braids on n-strands*, denoted by $B(n)$.

Continuing this work, later we will define a total ordering of the braid groups, which is invariant under multiplication on both sides. The ordering will be defined using a combination of Artin's combing technique and the Magnus expansion of free groups.

Recently, Rolfsen, Dynnikov, Dehornoy and Wiest, demonstrated topological reasons for the existence of a left-ordering of the braid groups over the disk, i.e., there is a strict total ordering of the braids that is invariant under multiplication from the left. They also showed the pure braid groups over the unit disk are bi-orderable, i.e., there is a left and right invariant strict total ordering for this group. In our master's project, we will study the results related with this topic, developed in [5].

References

[1] E. Artin, *Theory of braids*, Ann. of Math., 48 (1946), 101 − 126.
[2] Cohen, Daniel E. *Combinatorial group theory a topological approach*, Mathematical Society Student Texts 14. Cambridge University, **1989**.
[3] Hansen, Vagn L. *Braids and Covering: selected topics*, Mathematical Society Student Texts 18. Cambridge University, **1989**.
[4] D. L. Johnson, *Presentations of Groups*, 2nd ed., Cambridge University Press, (1997).
[5] Rolfsen D. Rolfsen, P. Dehornoy, I. Dynnikov and B. Wiest, *Ordering Braids*, Amer. Math. Soc., (2008).

(Letícia Melocro) ICMC-USP
E-mail address: `leticia.melocro@usp.br`

(Denise de Mattos) ICMC-USP
E-mail address: `deniseml@icmc.usp.br`

CALCULATING THE SINGULAR HOMOLOGY GROUPS OF SOME SPACES

RODRIGO DOS SANTOS BONONI AND ERMINIA DE L. CAMPELLO FANTI

The Homology Singular Theory provides us an interesting connection between Geometry and Algebra. For a topological space X, the homology groups associated $H_n(X)$ reflect the geometrical structure of X, the way the "holes" of X are arranged. However, calculate the singular homology groups of a space in general is not easy. If X is the union of two subspaces U and V, under suitable hypotheses there is an exact sequence relating the homology of X with that of U, V and $U \cap V$. It is called the Mayer-Vietoris sequence of the pair U and V. In this work we calculate the singular homology groups of some spaces using the Mayer-Vietoris sequence.

References

[1] Lima, E. L.; *Homologia Basica*, IMPA, RJ, **2009**.
[2] Vick, J. W.; *Homology Theory*, Academic Press, **1973**.

(Rodrigo dos Santos Bononi) Mat. - UNESP - IBILCE, SJRP. Bolsista: PET-MEC-SESU
E-mail address: `rodrigobononi@hotmail.com`

(Erminia de Lourdes Campello Fanti) DEP. MAT. UNESP - IBILCE, SJRP
E-mail address: `fanti@ibilce.unesp.br`

EQUISINGULARITY OF MAP GERMS FROM $\mathbb{C}^4, 0$ TO $\mathbb{C}^3, 0$

A. J. MIRANDA, M. J. SAIA, E. C. RIZZIOLLI, AND V. H. JORGE-PÉREZ

In this work we study the geometry of finitely determined map germs f in $\mathcal{O}_{4,3}$. First we study the critical locus of the germ and the discriminant (image of the critical locus by f). Last, we investigate the inverse image by f of the discriminant that is an hypersurface in the source with nonisolated singularity at the origin. From this, we show some relationship among the invariants needed to describe the Whitney equisingularity of families in these dimensions.

References

[1] Gaffney, T. *Polar Multiplicities and Equisingularity of Map Germs*, Topology, **1993**, 1, 185–223.

[2] Massey, D. *Le Cycles and Hypersurface Singularities*, Springer Lecture Notes in Mathematics, **1995**.

[3] Jorge-Pérez, V. H., Miranda, A. J. and Saia, M. J. *Couting Singularities via Fitting Ideals*, International Journal of Mathematics, World Scientific Publishing Company, **2012**, 1250062, 1–18.

[4] Hernandes, M. E., Miranda, A. J. and Peñafort-Sanchis, G. *A presentation matrix algorithm for $\mathcal{O}_{X,x}$*, https://sites.google.com/site/aldicio/publicacoes/presentation-matrix-algorithm, **2014**.

(A. J. Miranda) FAMAT-UFU
E-mail address: `aldicio@famat.ufu.br`

(M. J. Saia) ICMC-USP
E-mail address: `mjsaia@icmc.usp.br`

(E. C. Rizziolli) UNESP
E-mail address: `eliris@rc.unesp.br`

(V. H. Jorge-Pérez) ICMC-USP
E-mail address: `vhjperez@icmc.usp.br`

SOME EXAMPLE OF INVOLUTION FIXING $\mathbb{R}P^j \cup \mathbb{C}P^k$ WITH j AND k EVEN

AMANDA FERREIRA DE LIMA AND PEDRO LUIZ QUEIROZ PERGHER

The classification up to equivariant cobordism of smooth involutions having fixed set $\mathbb{R}P^j \cup \mathbb{C}P^k$, with j, k even, is a classical problem in cobordism theory. In the direction of finding a solution for this problem we study some examples of involutions with the fixed point in question. Certain examples are trivial or well-known. In this work we present a new example, specifically the involution $\Gamma(\mathbb{C}P^k, conjugation)$, and show that this example is effectively new.

References

[1] P. E. Conner and E. E. Floyd *LaTeX: Differentiable Periodic Maps*, Springer-Verlag, **1964**.

(Amanda Ferreira de Lima) Aluna de doutorado, UFSCar
E-mail address: a.flima@hotmail.com

(Pedro Luiz Queiroz Pergher) Professor Titular do Depto. de Matemtica, UFSCar
E-mail address: pergher@dm.ufscar.br

STRONG SURJECTIVITY OF MAPPINGS OF SOME 3-COMPLEXES WITH TWO 3-CELLS INTO $M_{Q_{16}}$

CLAUDEMIR ANIZ

Given a map $f : K \to M$ between topology spaces, and an arbitrary point $a \in M$, $MR[f, a] = \min\{\#(g^{-1}(a)) \mid g \in [f]\}$, where $[-]$ means a homotopy class. We say that a map $f : K \to M$ is *strongly surjective*, if any map homotopic to it is surjective or, equivalently, if $MR[f, a] \neq 0$ for some $a \in M$. Let K be a three dimension CW-complex with m cells of dimension 3, $1 \leq m \leq 2$, such that $H^3(K; \mathbb{Z}) = 0$ and $M_{Q_{16}}$ the orbit space of the 3-sphere $\mathbb{S}^3$ with respect to the action of the quaternion group Q_{16} determined by inclusion $Q_{16} \subseteq \mathbb{S}^3$. Given a point $a \in M_{Q_{16}}$, we show that there is no map $f : K \to M_{Q_{16}}$ which is strongly surjective.

(Claudemir Aniz) Universidade Federal de Mato Grosso do Sul
E-mail address: `claudemir.aniz@ufms.br`

ON THE DISCRIMINANTS OF MAP GERMS FROM $\mathbb{C}^{n+1}$ TO $\mathbb{C}^n$, $n = 3, 4$.

ELIRIS CRISTINA RIZZIOLLI

In this work we show some calculations involving Lê numbers and Euler characteristic of the Milnor fibre on discriminants of map germs from $\mathbb{C}^{n+1}$ to $\mathbb{C}^n$, $n = 3, 4$. In particular, we show that the Lê numbers are not invariant to the class of weight homogeneous map germs with same degree of homogeneity.

(Eliris Cristina Rizziolli) IGCE-UNESP, Rio Claro, S.P. Brasil.
E-mail address: eliris@rc.unesp.br

ON ROOTS FOR MAPS GOING FROM $\mathbb{R}P(3)$ TO S^2

GUSTAVO DE LIMA PRADO

In this work, first we classify up to homotopy the maps going from $\mathbb{R}P(3)$ to S^2. In order to do that, we first construct some maps and we enumerate them. Then we prove they are representatives for each homotopy class of maps going from $\mathbb{R}P(3)$ to S^2. Second we calculate the minimum number of coincidence components and the Nielsen number of (y_0, f) (as in [1] and [2]) for each of these homotopy classes and we find that they are both equal: or to 0 if f is nullhomotopic; or to 1 otherwise. We conclude in particular that f is deformable to be root free if and only if f is nullhomotopic. This work is part of the author's thesis, [3], under the advisory of Daciberg Lima Gonçalves and Ulrich Koschorke.

References

[1] Koschorke, U. *Selfcoincidences in higher codimensions*, J. Reine Angew. Math. 576, **2004**, 1-10.

[2] Koschorke, U. *Nielsen coincidence theory in arbitrary codimensions*, J. Reine Angew. Math. 598, **2006**, 211-236.

[3] Prado, G. L. *Coincidências em codimensão um e bordismo*, Tese de doutorado - USP, **2015**.

(Gustavo de Lima Prado) Universidade Federal de Uberlândia - UFU
E-mail address: `glprado@ufu.br`

BORSUK–ULAM AND BOURGIN–YANG THEOREMS FOR mod p-COHOMOLOGY SPHERES

NELSON A. SILVA, DENISE DE MATTOS, AND EDIVALDO L. DOS SANTOS

Bartsch [1] introduced a numerical cohomological index theory, known as the *length*, for G-spaces, where G is a compact Lie group. We present the length of G-spaces which are cohomology spheres and $G = (\mathbb{Z}_2)^k$, $(\mathbb{Z}_p)^k$ or $(S^1)^k$, $k \geq 1$. As consequences, we obtain a Borsuk–Ulam theorem in this context and give a sufficient condition for the existence of G-map between a cohomological sphere and a representation sphere when $G = (\mathbb{Z}_p)^k$. Also, a Bourgin–Yang version of the Borsuk–Ulam theorem is presented.

References

[1] Bartsch, T. *Topological Methods for Variational Problems with Symmetries*, Lecture Notes in Mathematics 1560, Springer-Verlag Berlin Heidelberg, **1993**.
[2] Dieck, T. *Transformation Groups*, de Gruyter, Berlin, **1987**.
[3] Fadell, E. R. and Husseini, S. *An ideal-valued cohomological index theory with applications to Borsuk-Ulam and Bourgin-Yang theorems*, Ergodic Theory Dynam. Systems 8, Charles Conley Memorial Issue, 73-85, **1988**.
[4] Segal, G. *Equivariant K-theory*, Publ. Math. IHES **34** 129-151, **1968**.

(Nelson A. Silva) ICMC-USP
E-mail address: `nelson@icmc.usp.br`

(Denise de Mattos) ICMC-USP
E-mail address: `deniseml@icmc.usp.br`

(Edivaldo L. dos Santos) DM-UFSCar
E-mail address: `edivaldo@dm.ufscar.br`

DICHOTOMY BETWEEN DENSITY FOLIATIONS AND SUSPENSIONS FOR ANOSOV ACTIONS

RODRIGO RIBEIRO LOPES AND CARLOS ALBERTO MAQUERA APAZA

We will talk about of certain properties of an Anosov action $\phi : \mathbb{R}^k \times M \to M$. In particular, we are interested to solve the Verjosky's conjectured for actions. The conjectured says *"Every irreducible codimension-one Anosov action of* $\mathbb{R}^k$ *on a manifold* M*,* $\dim M \geq k+3$*, is topologically conjugate to the suspension of an Anosov action of* $\mathbb{Z}^k$ *on a closed manifold."*

In order to solve this problem for $k = 1$, Plante[1] proved a lot of results about Anosov flows. In particular, he exhibited a criterion for Anosov flow to be a suspension of homeomorphism. The criterion is the following dichotomy, either each strong unstable leaf and strong stable leaf is dense on M or the flow ϕ^t is a suspension of an Anosov diffeomorphism. In this work, we will show the same dichotomy for irreducible codimension-one Anosov action.

References

[1] Plante, J.F. *Anosov flows*, 94, $729 - 754$, American Journal of Math, **1972**.
[2] Ghys, E. *Codimension one Anosov flows and suspensions*, 1331, $59 - 72$, Springer, **1988**.
[3] Barbot, T. and Maquera,C. *Transitivity of codimension-one Anosov actions of* $\mathbb{R}^k$ *on closed manifold*, 31, $1 - 22$, Ergodic Theory and Dynamical Systems, **2011**.

(Rodrigo Ribeiro Lopes) ICMC - USP
E-mail address: `rodrigoribeirolopes@gmail.com`

(Carlos Maquera) ICMC-USP
E-mail address: `cmaquera@icmc.usp.br`

(H, G)-COINCIDENCE THEOREMS FOR MANIFOLDS

TACIANA O. SOUZA AND DENISE DE MATTOS

Let G be a finite group which acts freely on a space X and let $f : X \to M$ be a continuous map from X into another space M. If H is a subgroup of G, then H acts on the right on each orbit Gx of G as follows: if $y \in Gx$ and $y = gx$, $g \in G$, then $hy = ghx$. A point $x \in X$ is said to be a (H, G)- *coincidence point* of f if f sends every orbit of the action of H on the G-orbit of x to a single point (See [1]). The set of all (H, G)-coincidence points is denoted by $A(f, H, G)$. Let X be a paracompact space and let H a cyclic subgroup of G of prime order p. Let $f : X \to M$ be a continuous map where M is a connected m-manifold (orientable if $p > 2$) and $f^*(V_k) = 0$, for $k \geq 1$, where V_k are the Wu classes of M. Suppose that $\operatorname{ind} X \geq n > (|G| - r)m$, where $\operatorname{ind} X$ denotes the index of the free $\mathbb{Z}_p$-space X and $r = \dfrac{|G|}{p}$. In this work we estimate, using results in [2] and [3], the cohomological dimension of the set $A(f, H, G)$ of (H, G)-coincidence points of f.

References

[1] Gonçalves, D.L.; Jaworowski, J.; Pergher, Pedro L.Q., *Measuring the size of the coincidence set*, Topology Appl. **125** (2002), 465–470.

[2] De Mattos, Denise; Dos Santos, Edivaldo L., *On nonsymmetric theorems for* (H, G)-*coincidences.* Topological Methods in Nonlinear Analysis, v. 33, (2009) 105-120.

[3] Volovikov, A. Yu., *Mappings of free Zp-spaces into manifolds*, Izv. Akad. Nauk SSRR Ser. Math., (46) n.1, (1992) 36–55.

(Taciana O. Souza) FAMAT - UFU
E-mail address: taciana@famat.ufu.br

(Denise de Mattos) ICMC - USP
E-mail address: deniseml@icmc.usp.br