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Algorithmic and theoretical issues related to automatic computation of the homological Conley index over the phase space for semidynamical systems with discrete time

This ESF exchange visit (Ref. 5578) of Dr. Jacek Szybowski (AGH University of Technology, Krakow, Poland) at the University of Minho, Braga, Portugal took place on June 17-24, 2013. It was part of the project aimed at the development of an algorithmic method for the computation of the homological Conley index over the phase space conducted by Dr. Szybowski, Dr Pawel Pilarczyk (University of Minho, Braga, Portugal) and Dr. Kinga Stolot (AGH University of Technology, Krakow, Poland). It was also the continuation of the work undertaken during the short visit of Dr. Pawel Pilarczyk at the AGH University of Technology, Krakow, Poland in May, 2012 and during my visit to Dr. Paweł Pilarczyk at the University of Minho, Braga, Portugal in August, 2012.

The purpose of the visit was to resolve various algorithmic and theoretical issues related to the computation and interpretation of the homological objects (spaces and homomorphisms) that are the key ingredients in the computation of the homological Conley index over the phase space.

During the visit, we were discussing several examples of the semidynamical systems with discrete time. We were trying to apply the homological Conley index over the phase space to prove the lack of continuation between the isolated invariant sets existing in phase spaces of the discussed systems. These examples have shown that our construction needs some improvements, and we are going to work on this topic in the nearest future.

The main result that we achieved during the visit was the development of an algorithm for automatic construction of Kaczynski-Mrozek's style index pairs in an isolating neighborhood (as opposed to Szymczak's index pairs, which we had already been able to construct). This

type of the index pairs is required by the formal definition of the Conley index over the phase space which we are using in the current project.

In the nearest future we hope to implement the obtained algorithm and test it on the discussed two- and three-dimensional examples of semidynamical systems. We also intend to complete the paper describing the results of our work and to publish it in an international peer-refereed academic journal. We have already started writing up the first draft of it during the visit.

As far as the future cooperation between Dr. Szybowski and Dr. Pilarczyk is concerned, we plan to work on the additivity property of the index, prepare more interesting and higher-dimensional examples, and continue our academic collaboration with the ultimate goal of developing suitable theoretical basis and algorithms for the computation of the index over a general base (not necessarily the phase space).