EXAMPLE ARTICLE IN FORUM OF APPLIED MATHEMATICS

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1. Introduction

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2. Theorems, definitions and formulas

Throughout this paper X denotes a compact metric space and φ denotes a flow on X, i.e. a continuous map $\varphi\colon \mathbb{R}\times X \longrightarrow X$ satisfying:

$$\begin{aligned}\varphi(0,x) &= x,\\ \varphi(t,\varphi(s,x)) &= \varphi(t+s,x).\end{aligned}$$

If $I\subset\mathbb{R}$ and $A\subset X$, then $\varphi(I,A) := \{\varphi(t,x)\,|\,t\in I \,\mathrm{and}\, x\in A\}$. For a given subset $N\subset X$ the set $\mathrm{Inv}(N) := \{x\in X\,|\,\varphi(\mathbb{R},x)\subset N\}$ is called the *invariant part* of N. We say that $S\subset X$ is *invariant* if $\mathrm{Inv}(S)=S$.

Recall that given a set $Y\subset X$ the *positive limit set* of Y is given by

$$\omega^+(Y) := \bigcap_{t>0}\mathrm{cl}(\varphi([t,\infty),Y))$$

and the *negative limit set* of Y is given by

$$\omega^-(Y) := \bigcap_{t<0}\mathrm{cl}(\varphi((-\infty,t],Y)).$$

Let $S\subset X$ be a compact invariant set. A compact set $N\subset X$ is called an *isolating neighborhood* if $\mathrm{Inv}(N)\subset\mathrm{int}(N)$. S is called an *isolated invariant set* if $S=\mathrm{Inv}(N)$ for some isolating neighborhood N. A subset $A\subset L$ is called *positively invariant* in L if given $x\in A$ and $\varphi([0,t],x)\subset L$, then $\varphi([0,t],x)\subset A$. A subset A of L is called an *exit set* for L if given

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$x \in L$ such that $\varphi([0,\infty),x) \not\subset L$, then there exists $t \geq 0$ such that $\varphi([0,t],x) \subset L$ and $\varphi(t,x) \in A$.

Let S be an isolated invariant set. A pair of compact sets (N^1, N^0) is called an *index pair* for S if:

(i) $S = \mathrm{Inv}(\mathrm{cl}(N^1 \setminus N^0)) \subset \mathrm{int}(N^1 \setminus N^0)$,
(ii) N^0 is positively invariant in N^1,
(iii) N^0 is an exit set for N^1.

We give two more definitions from the Conley index theory. Let S be an isolated invariant set.

Definition 2.1. A collection $\{M_i\}_1^n$ of mutually disjoint compact invariant subsets of S is a *Morse decomposition* of S if for every $x \in S \setminus \bigcup_{i=1}^n M_i$ there are indices $i < j$ such that $\omega^+(x) \subset M_i$ and $\omega^-(x) \subset M_j$.

The sets M_i are called *Morse sets.* Moreover, we define generalized Morse sets for $i \leq j$:

$$M_{ji} := \{x \in S \,|\, \omega^+(x) \cup \omega^-(x) \subset \bigcup_{k=i}^{j} M_k\}. \tag{2.1}$$

In particular, $M_{jj} = M_j$. It is easy to check that all sets (2.1) are isolated invariant sets.

Definition 2.2. An *index filtration* for the Morse decomposition $\{M_i\}_1^n$ is a collection of compact sets $\{N^i\}_0^n$ such that

(1) $N^0 \subset N^1 \subset \ldots \subset N^n$,
(2) for any $i \leq j$: (N^j, N^{i-1}) is an index pair for M_{ji}.

Let us formulate natural

Theorem 2.3. *For any given Morse decomposition there exists an index filtration.*

Proof. This was proved by Salamon [2]. □

3. Tables and figures

In this section we present numerical simulations for a continuous and discontinuous initial function ω. Assume that $\mu = 0.2$, $d = 1$, $m = 1$, $b_0 = b_m = 0.3$ and $\gamma = 0$. Figs. **??** and **??** show numerical simulations in two cases: $c_0 + c_m > 0$ and $c_0 = c_m = 0$.

TABLE 1. Data from last year

	X	Y	Z	W
F	0.1234	0.2111	0.3492	0.2413
G	0.2245	0.2341	0.3122	0.1113

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References

[1] C. Conley, *Isolated Invariant Sets and the Morse Index*, CMBS Reg. Conf. Ser. in Math. 38, AMS, Providence, RI 1978.

[2] D. Salamon, *Connected simple systems and the Conley index of isolated invariant sets*, Trans. AMS 291(1985), 1–41.

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