

# New Trends in Onedimensional Dynamics

## Celebrating the 70<sup>th</sup> anniversary of Welington de Melo

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**Title:** Lyapunov exponents for expansive homeomorphisms and expansive set valued maps

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**Abstract:** Let  $(M, \rho)$  be a compact metric space and  $f : M \rightarrow M$  an expansive homeomorphism with  $\alpha > 0$  an expansivity constant. We define Lyapunov exponents  $\Lambda(f, \mu)_{max}$  and  $\lambda(f, \mu)_{min}$  for an  $f$ -invariant measure  $\mu$  and prove that if  $M$  is a Peano space then there is  $\gamma > 0$  such that  $\Lambda(f, \mu)_{max} > \gamma$  and  $\lambda(f, \mu)_{min} < -\gamma$ . Moreover we define Lyapunov exponents for  $K$ , a compact  $f$ -invariant subset of  $M$ . We prove that if the maximal Lyapunov exponent of  $K$  is negative then  $K$  is an attractor. We generalize these results to expansive multivalued functions. More precisely, we define Lyapunov exponent  $\chi(F, \mu)_{max}$  for expansive Hausdorff-continuous maps defined on a compact manifold  $M$ . Expansiveness is defined using the Hausdorff metric on compact subsets. We prove that when  $F(x)$  is acyclic for every  $x \in M$  then  $\chi(F, \mu)_{max} > 0$ . Here  $\mu$  is an  $F$ -invariant measure in the sense of [?].