Topological persistence in symplectic topology seminar

Plan of the talks

Talk 1: **Introduction to persistence modules and barcodes (16/04)**. – Thibaut Mazuir

(i) Definition of persistence modules, examples (Morse persistence module and Rips module)

(ii) Morphisms of persistence modules, shift morphisms, the category of persistence modules is an abelian category

(iii) Interval modules, basic properties, definition of barcodes, normal form theorem and glimpse of proof

(iv) Interleaving distance, bottleneck distance, isometry theorem

(v) Application: quantitative obstruction to the approximation of a Morse function on the heart-shaped sphere

Chapters 1-4 in [PRSZ20]

Talk 2: **Filtered Hamiltonian Floer homology, Hofer's metric and the dynamical stability theorem (30/04)**. – Wennan Zhang

(i) Recollections on Hamiltonian Floer homology with a few words about the Conley-Zehnder index

Sections 8.1 and 8.2 in [PRSZ20]

(ii) The group of Hamiltonian diffeomorphisms and its properties, Hofer's metric and displacement energy

Sections 7.3 and 7.4 in [PRSZ20] *and chapters 1 and 2 in* [Pol01]

(iii) Hamiltonian persistence module, the dynamical stability theorem and its proof

Section 8.2 in [PRSZ20]

(iv) Embedding problems, Gromov's nonsqueezing theorem and examples of symplectic capacities including the displacement energy capacity

Section 7.6 in [PRSZ20] *and section 2 in* [CHLS07]

Talk 3: **Constraints on p-th powers of Hamiltonian diffeomorphisms (07/05)**. – ?

Selected pieces of [PS16]

Talk 4: **Bounds on the spectral norm and Lagrangian Hofer metric via barcodes (14/05)**. – Muhammed E Guelen

Selected pieces of [KS21] *and* [Die23]

Talk 5: Triangular persistence Fukaya categories and pseudo-metrics on Lagrangian submanifolds (14/05). – Viktor Majewski

The goal of this talk is to state Theorem 3.4 and Corollary 3.7 of [BCZ23b] and sketch the main constructions underlying these two results. The talk should be divided into two parts.

(i) The first part should be a concise summary of the algebraic constructions presented in Chapter 2 that are necessary for the statement of the two main results of the talk. Following the summary presented in Section 1.1 might help the reader navigate through Chapter 2.

(ii) The second part should consist of an overview of Section 3.1 culminating with the statement of Theorem 3.4 and Corollary 3.7. It shouldn't include too many details about technical assumptions but rather sketch the intuition behind these two results as well as their main consequences.

Talk 6: Distinguishing Legendrian knots (11/06). – David Suchodoll

Selected pieces of [BCC+23]

Talk 7: Introduction to symplectic homology (18/06). – Michael Rothgang

Talk 8: Symplectic persistent modules and symplectic Banach-Mazur distance (25/06). – Shah Faisal

Talk 9: Legendrian persistence modules and dynamics (02/07). – ?

Selected pieces of [EP22]

Talk 10: (09/07). – ?

Talk 11: (16/07). – ?

References

[BCC+23] Maya Basu, Austin Christian, Ethan Clayton, Daniel Irvine, Fredrick Mooers, and Weizhe Shen. Persistent Legendrian contact homology in $\mathbb{R}^3$, 2023. arXiv:2312.09144.

[BCZ23a] Paul Biran, Octav Cornea, and Jun Zhang. Persistence K-theory, 2023. arXiv:2305.01370.

[BCZ23b] Paul Biran, Octav Cornea, and Jun Zhang. Triangulation, Persistence, and Fukaya categories, 2023. arXiv:2304.01785.

[CHLS07] Kai Cieliebak, Helmut Hofer, Janko Latschev, and Felix Schlenk. Quantitative symplectic geometry. In *Dynamics, ergodic theory and geometry. Dedicated to Anatole Katok. Based on the workshop on recent progress in dynamics, Berkeley, CA, USA, from late September to early October, 2004*, pages 1–44. Cambridge: Cambridge University Press, 2007.

[Die23] Patricia Dietzsch. Bounding the Lagrangian Hofer metric via barcodes, 2023. arXiv:2304.05628.

[EP22] Michael Entov and Leonid Polterovich. Legendrian persistence modules and dynamics. *J. Fixed Point Theory Appl.*, 24(2):54, 2022. Id/No 30.

[KS21] Asaf Kislev and Egor Shelukhin. Bounds on spectral norms and barcodes. *Geom. Topol.*, 25(7):3257–3350, 2021.

[Pol01] Leonid Polterovich. *The geometry of the group of symplectic diffeomorphism.* Basel: Birkhäuser, 2001.

[PRSZ20] Leonid Polterovich, Daniel Rosen, Karina Samvelyan, and Jun Zhang. *Topological persistence in geometry and analysis*, volume 74 of *Univ. Lect. Ser.* Providence, RI: American Mathematical Society (AMS), 2020.

[PS16] Leonid Polterovich and Egor Shelukhin. Autonomous Hamiltonian flows, Hofer's geometry and persistence modules. *Sel. Math., New Ser.*, 22(1):227–296, 2016.