

**Final report on the workshop**  
Legendrian submanifolds, holomorphic curves and  
generating families  
Brussels, August 26-30 2013

## Scientific summary

The goal of this workshop was to bring together researchers working on Legendrian submanifolds using different techniques. These include topics as varied as generating families, holomorphic curves, microlocal analysis, and h-principles.

The topics covered by this workshop included:

- The relation between generating family homology and linearized Legendrian contact homology in dimension 3, and its expected generalization in higher dimension.
- The application and extension of 3-dimensional computational techniques to higher dimensions.
- The study of loose Legendrian submanifolds and Legendrian submanifolds with few Reeb chords.
- The construction of  $A_\infty$  algebras associated to Legendrian submanifolds.
- The study of Lagrangian cobordisms between Legendrian submanifolds.

## Meeting programme

This workshop took place from Monday, August 26th to Friday, August 30th 2013 at the Royal Academy of Belgium, in Brussels.

It was composed both of formal talks (in the morning) and of informal discussions and problem sessions (in the afternoon). Each day was devoted to a consistent theme or technique within the scope of the workshop:

**Monday:** Contactomorphisms via generating families and holomorphic curves  
**Tuesday:** Flexibility and few Reeb chords

**Wednesday:** Generating families vs holomorphic curves

**Thursday:** Three approaches to  $A_\infty$ -structures

**Friday:** Constructions and invariants

In the afternoon, more material was presented at the request of the audience, and informal presentations on speculations, unsuccessful attempts and examples will be used to let the participants interact as much as possible, but without imposing a specific format.

	Monday	Tuesday	Wednesday	Thursday	Friday
<b>9:00</b>	Sandon	Sullivan	Fuchs	Henry	Golovko
<b>10:00</b>	Coffee/tea break	Coffee/tea break	Coffee/tea break	Coffee/tea break	Coffee/tea break
<b>10:30</b>	Zénaïdi	Niederkrüger	Rutherford	Chantraine	Sabloff
<b>11:30</b>	Colin	Ekholm	Brönnle	Treumann	Dimitroglou Rizell
<b>12:30</b>	Lunch buffet	Lunch buffet	Lunch buffet	Lunch buffet	Lunch buffet
<b>14:30</b>	Discussion 1	Discussion 1	Discussion 1	Discussion 1	Discussion 1
<b>15:30</b>	Coffee/tea break	Coffee/tea break	Coffee/tea break	Coffee/tea break	Coffee/tea break
<b>16:00</b>	Discussion 2	Discussion 2	Discussion 2	Discussion 2	Discussion 2

The topics of the talks were:

**Sandon:** Translated points of contactomorphisms via generating families.

**Zénaïdi:** Legendrian contact homology in contact products.

**Colin:** Bi-invariant metrics on the group of contactomorphisms.

**Sullivan:** Decompositions for Legendrian contact homology.

**Niederkrüger:** A flexibility result in high-dimensional contact topology.

**Ekholm:** Legendrian submanifolds with few Reeb chords.

**Fuchs:** Generating family homology and Chekanov-Eliashberg DGA.

**Rutherford:** Ruling polynomials and augmentations over finite fields.

**Brönnle :** Wrapped Floer homology for families.

**Henry:** Higher combinatorial invariants for Legendrian knots and surfaces.

**Chantraine:** Bilinearized legendrian contact homology.

**Treumann:** A category for Legendrian submanifolds from microlocal analysis.

**Golovko:** Some constructions of Legendrian submanifolds and Lagrangian cobordisms.

**Sabloff:** Generating family invariants for Legendrian submanifolds and the geography problem.

**Dimitroglou Rizell:** Rigidity and flexibility for Lagrangian cobordisms.

The contents of the afternoon discussions can be summarized as follows.

**Monday:** More material presented about ongoing research about translated points of contactomorphisms.

**Tuesday:** Work in smaller groups about flexible Legendrians and over-twisted contact manifolds.

**Wednesday:** More material presented on the relation between generating family homology and linearized Legendrian contact homology.

**Thursday:** Discussions on further developments based on the comparison between the various approaches exposed in the morning.

**Friday:** Work in smaller groups to complete the discussions initiated earlier in the week.

## List of participants

This workshop involved a total of 32 participants. This number was limited due to the rather focused nature of this workshop, and in order to favor better interactions between the participants.

The participants consisted both of experts in the topics of the workshop and of younger researchers or doctoral students working in the field.

The participants were:

1. Mélanie Bertelson (Université Libre de Bruxelles)
2. Frédéric Bourgeois (Université Libre de Bruxelles)
3. Till Brönnle (Université Libre de Bruxelles)
4. Baptiste Chantraine (Université de Nantes)
5. Marc Chaperon (Université Paris Diderot - Paris 7)
6. Vincent Colin (Université de Nantes)
7. Sylvain Courte (Ecole Normale Supérieure de Lyon)
8. Georgios Dimitroglou Rizell (Université Libre de Bruxelles)
9. Tobias Ekholm (Uppsala Universitet)
10. Emmanuel Ferrand (Université Pierre et Marie Curie - Paris 6)
11. Dmitry Fuchs (University of California at Davis)

12. Hansjörg Geiges (Universität zu Köln)
13. Roman Golovko (Université Libre de Bruxelles)
14. Jean Gutt (Université Libre de Bruxelles)
15. Brad Henry (Siena College)
16. Rémi Leclercq (Université Paris-Sud - Paris 11)
17. Maÿlis Limouzineau (Université Pierre et Marie Curie - Paris 6)
18. Samuel Lisi (Université de Nantes)
19. Marco Mazzucchelli (Ecole Normale Supérieure de Lyon)
20. Klaus Niederkrüger (Université Paul Sabatier - Toulouse III)
21. Marcelo Ribeiro de Resende Alves (Université Libre de Bruxelles)
22. Dan Rutherford (University of Arkansas)
23. Josh Sabloff (Haverford College)
24. Margherita Sandon (Université de Nantes)
25. Jean-Claude Sikorav (Ecole Normale Supérieure de Lyon)
26. Michael Sullivan (University of Massachusetts)
27. David Treumann (Northwestern University)
28. Anne Vaugon (Ecole Normale Supérieure de Lyon)
29. Vera Vertesi (Université de Nantes)
30. Frol Zapolsky (University of Haifa)
31. Kai Zehmisch (Universität zu Köln)
32. Naïm Zénaïdi (Université Libre de Bruxelles)

## Feedback

Many participants expressed explicitly the appreciation of the workshop organization. The most recurrent comments were about:

- the moderate number of talks each day, allowing to absorb the exposed content,
- the coherent themes for the talks and discussions for each day,
- the discussions organized in a free format, allowing exchanges and collaborative work without forcing a particular way for working in groups,
- the proximity of the accommodations and the lunches served at the workshop venue, allowing the participants to stay in touch during the whole day.

The participants took part in the afternoon discussions differently, depending on their particular style. Overall, there was a mixture of people working in smaller or in larger groups, either to work on a given ongoing research project or to explain to each other their respective techniques and see what that this could bring to their own research. During the course of this workshop, a couple of papers were written by already collaborating researchers. In view of the interactions that took place, it seems that several new collaborations were formed, but it is too early to have joint papers demonstrating these positive developments.

## Budget

The expenditures for this workshop worked out as planned. The total amount spent is estimated as 43 kEUR, as planned, although the exact amount is not known yet, due to important delays in the work of the ULB administration and accounting services.

The local sources of funding were modified, in the sense that the funds from the ULB Foundation were used to cover 35 kEUR, and to other sources of local funding were not used. This is because the organizer left ULB to become a professor at the Université Paris-Sud just after the workshop, and the ULB Foundation funds would not remain available after that. The ERC grant of the organizer was transferred to his new institution, so that these

funds will remain available in the future.

The 8000 EUR contribution from ESF and CAST was used to fund travel and accommodation for several participants. More specifically, 2935 EUR were used to cover the accommodations of M. Sullivan, J. Sabloff, M. Limouzeau, K. Zehmis, A. Vaugon and V. Vertesi. Then, 5065 EUR were used to cover the travel expenses of B. Henry, H. Geiges, M. Sullivan, M. Chaperon, B. Chantraine, M. Mazzucchelli, E. Ferrand, R. Leclercq, M. Limouzeau, A. Vaugon, D. Treumann and D. Rutherford.