Sommersemester 2016

Seminar: Selected Topics in the Calculus of Variations

Alexander Mielke and Karoline Disser

Contents of the Seminar:
Specialization and extension of topics discussed in the
Lecture Course *Multidimensional Calculus of Variations*
(Disser/Mielke, WiSe 2015/16):

Schedule (as of 18. Mai 2016)

1.	Tuesday 19. April 2016: 13:00–14:30 h, room **1.012**:	Organisation "How to give a talk"
2.	Wednesday 18. Mai 2016 11:15–17:00 h, room **1.315**:	(3 talks) M. Bahn, L. Gehring, S. Hensel
3.	Wednesday 1. June 2016 10:30–17:00 h, room **1.315**:	(4 talks) L. Schmollack, T. C. Rosati, F. Bethke, N. Farchmin
4.	Monday 27. June 2016 9:15–12:30 h + 15:00–16:30 h, room **1.315**	(3 talks) P. Kumar, S. Schwöbel, A. Stephan

Participants

(ordered by talks)

1: Marcus Bahn, bahnmarcus@gmail.com
2: Lukas Gehring, gehring@math.hu-berlin.de
3: Sebastian Hensel, Sebastian_Hensel@gmx.net
4: Luzie Schmollack, schmolll@hu-berlin.de
5: Tommaso C. Rosati, t.r.cornelis@gmail.com
6./7.: Franz Bethke: bethke@math.hu-berlin.de
6./7.: Nando Farchim: farchmin@math.hu-berlin.de
8: Pawan Kumar, pkumar@protonmail.ch
9: Stephan Schwöbel: schwoebe@math.hu-berlin.de
10. Artur Stephan: stephan@math.hu-berlin.de

List of Talks

1. (Bahn) Topology of Γ-convergence [Dal93, Ch. 10]
2. (Gehring) Christmas problem 2016 (see Exercise Sheet 10)
3. (Hensel) Lower semicontinuity via Ioffe's theorem [Ber74, Iof77, Dac08, FoL07]
4. (Schmollack) Rockafellar's theorem: $(I_f)^* = I_{f^*}$ via ∂I_f, [Roc68, Roc71]
5. (Rosati) Dimension reduction via Γ-convergence [Bra02, Int., Ch. 14], [Bra06, Sect. 9], [BC*92, LeR00]
6.+7. (Bethke/Farchmin) Γ-convergence and Legendre–Fenchel transform, I+II [Att84, Th. 3.9+3.11] and [Att84, Th. 3.18+3.26]
8. (Kumar) Phase transitions [Bra02, Int., Ch. 6+15], [Bra06, Sect. 7], [Dal93]
9. (Schwöbel) Multidimens. homogenization [Bra06, Sect. 5], [Dal93, Ch. 24+25]
10. (Stephan) Passage from discrete to continuum via Γ-convergence [Bra02, Ch. 14], [Bra06, Sect. 11], [BrG02a, BrG02b]
11. Quasiconvexity implies lower semicontinuity [AcF84, Dac08]
12. Γ-convergence for quadratic functionals [Dal93, Ch. 11–13], [Att84, Ch. 3.1–3.4]

Literature

[AcF84] E. Acerbi and N. Fusco. Semicontinuity problems in the calculus of variations. *Arch. Rational Mech. Anal.*, 86(2), 125–145, 1984.

[Att84] H. Attouch. *Variational Convergence of Functions and Operators*. Pitman, 1984.

[BC*92] F. Bourquin, P. G. Ciarlet, G. Geymonat, and A. Raoult. Γ-convergence and asymptotic analysis of thin plates. *C. R. Acad. Sci., Paris, Sér. I*, 315(9), 1017–1024, 1992.

[Ber74] L. D. Berkovitz. Lower semicontinuity of integral functionals. *Trans. Amer. Math. Soc.*, 192, 51–57, 1974.

[Bra02] A. Braides. Γ-*Convergence for Beginners*. Oxford University Press, 2002.

[Bra06] A. Braides. A handbook of Γ-convergence. In "M. Chipot and P. Quittner, editors, *Handbook of Differential Equations. Stationary Partial Differential Equations. Volume 3.* Elsevier, 2006." Pages 101–213.

[BrG02a] A. Braides and M. S. Gelli. Continuum limits of discrete systems without convexity hypotheses. *Math. Mech. Solids*, 7, 41–66, 2002.

[BrG02b] A. Braides and M. S. Gelli. Limits of discrete systems with long-range interactions. *J. Convex Anal.*, 9, 363–399, 2002.

[Dac08] B. Dacorogna. *Direct Methods in the Calculus of Variations* (2^{nd} ed). Springer, 2008.

[Dal93] G. Dal Maso. *An Introduction to* Γ-*Convergence*. Birkhäuser, 1993.

[FoL07] I. Fonseca and G. Leoni. *Modern Methods in the Calculus of Variations: L^p spaces*. Springer, 2007.

[Iof77] A. D. Ioffe. On lower semicontinuity of integral functionals. I. *SIAM J. Control Optimization*, 15(4), 521–538, 1977.

[LeR00] H. Le Dret and A. Raoult. Variational convergence for nonlinear shell models with directors and related semicontinuity and relaxation results. *Arch. Rational Mech. Anal.*, 154(2), 101–134, 2000.

[Roc68] R. T. Rockafellar. Integrals which are convex functionals. *Pacific J. Math.*, 24(3), 525–539, 1968.

[Roc71] R. T. Rockafellar. Integrals which are convex functionals, II. *Pacific J. Math.*, 39(2), 439–469, 1971.

Two-part contribution to seminar

1. Talk: **blackboard presentation of 50–60 minutes**

2. Lecture notes: **LaTeX document of 6 to 10 pages**
(12pt size, textwidth 16cm, textheight 23 cm)

A written text is different from a talk: it should contain full sentences and many explanations (see $\mathbf{W}^4$ below) in addition to the mathematical details.

Preparation of Talk:

On the web, you can find many helpful material on how to give a (mathematical) talk.

Top priority:
your audience gets something to take home and doesn't get bored.

Important steps in your preparation:
• careful selection of contents, prioritize, focus on essentials
• develop a story in such way that your audience always knows "where they are" (roter Faden)

Important techniques:
• Figures and examples (visualize complicated things in a simple way)
• Free speech (enables you to interact with your audience, automatically ensures better structure of your talk)

Please make at least **two appointments** ahead of your talk:
• with Alexander Mielke,
for discussing and fixing the (mathematical) content of your talk,

• with Karoline Disser, approx. **two weeks** before your talk.
For discussing the structure of your talk, please prepare:
(1) a full draft of what you will put on the blackboard
(2) a three-minutes talk that summarizes the essentials of your complete talk (helps with adding structure)

Criteria for a good talk:

Following up on our discussion in the first meeting, here is a list of criteria for good talks. We offer to grade these criteria after your talk, to give you feedback you can use to improve you future talks. These grades are optional – please don't hesitate to let us know (individually or collectively) if you don't want them. Please also let us know if you would like to add more.

- Contents:
  - $\mathbf{W}^4$: **W**hat, **W**hy, ho**W**, **W**ho (else)
    (spend more than 50 % of time on explanations and relations)
  - mathematical correctness
  - comprehensiveness and elaborateness
  - examples and counterexamples
  - your grasp of the subject
  - response to questions
- Structure:
  - motivation
  - clarity
  - appropriate redundance
  - take-home message?
- Speech:
  - comprehensibility
  - appropriate speed
  - flow of words
  - interaction with audience
  - gestures etc.
- Blackboard:
  - readability
  - structure
  - figures