



Welcome to Advanced Studies Course on
Joint Inversion of Receiver Functions and
Surface Waves - EXERCISES

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- About You and Advances Studies Course -

Why on Earth are YOU here?

- This course is something you always wanted to take
- You need another course to get a credit from your employer
- A computer glitch at IRIS registration office
- Just curious...

What can YOU learn?

- What we know and what we do not know about the Earth using RFs and SW dispersion
- How to put your knowledge about your local network/geology to work
- Expand your horizons – studying lithospheric structure is multidisciplinary and cool
- Think about pursuing your PhD or MS in Earth Physics

What tools can YOU use?

- Read the README files
- Follow the steps
- Participate in the class - ask questions - come see me during dinner - be proactive

- About Me -

Name

Hrvoje Tkalčić - a difficult to pronounce Croatian name, but could probably be worse :)
pronunciation tip: [Hrr voaye Tkal tcheech]

Education

1996 University diploma in physics, speciality in geophysics from University of Zagreb, Croatia
(lived in Croatia 26 yrs)

2001 Ph.D. in geophysics from University of California at Berkeley, California
(lived in California 10 yrs; graduated 1 year too early to get Schwarzeneger's signature on my diploma)

Present position

Fellow in seismology, Earth Physics, RSES, ANU

Research interests

- Observational global seismology; studying the Earth's interior with special interest in deep Earth structure - the inner and outer core, the core mantle boundary and the lowermost mantle; interpretation of seismic results in the context of understanding Earth's dynamic past, present and future;
- Non-tectonic environment earthquakes with anomalous seismic radiation and puzzling earthquake mechanisms (e.g. volcanic earthquakes, explosions, etc.);
- Lithospheric structure using receiver functions, surface waves and other seismological techniques;
- Deployments of seismic instrumentation on Earth and planetary surfaces and improvement of spatial sampling of Earth's interior by seismic body waves.

Required by all students:

While in the lecture/exercises, please DO:

- Ask questions when anything is not clear
- Engage in the discussions
- Fully participate in in-class exercises

Required software

- (1) Pgplot
- (2) Java
- (3) SAC
- (4) GMT
- (5) Compilers: g77, gcc, gfortran

AGENDA OF THE ADVANCED STUDIES COURSE IN JOINT INVERSION OF RECEIVER FUNCTIONS AND SURFACE WAVE DISPERSION

SATURDAY - JANUARY 19

9:00-9:30 AM (**Tkalcic/Julia**)

- Introduction to the Course; A brief overview of lectures and practical exercises (**Tkalcic/Julia**);

9:30-10:30 AM (**Sandvol**)

- Introduction and theory of receiver functions; Description of methods available to process data and prepare receiver functions (**Sandvol**);

10:45-12:00 AM (**Pasyanos**)

- Overview of research and recent results using receiver functions (**Pasyanos**);
-

1:30-3:30 PM (**Frassetto**)

- Overview of software and requirements; Installation of software and computer system checks (**Frassetto**);

4:00-6:00 PM (**Tkalcic**)

- **EXERCISE 1** – Preparation of structural models and synthetic waveforms including deconvolution and computation of receiver functions (**Tkalcic**);
- **EXERCISE 2** – Preparation of observed waveforms for selected stations including deconvolution and computation of receiver functions; preparation of dispersion data (**Tkalcic**);

SUNDAY - JANUARY 20

9:00-10:30 AM (**Julia**)

- Introduction to receiver function inversions; Description of methods available for forward and inverse modelling (**Julia**);

10:45-12:00 AM (**Frassetto**)

- Stacking receiver functions; H-K method and its variants; overview of theory, recent papers and software (**Frassetto**);

1:30-3:30 PM (**Tkalcic/Julia**)

- Questions & answers regarding Exercise 1 & 2 (**Tkalcic**);
- **EXERCISE 3** – Forward modelling of receiver functions using interactive forward modeller IRFFM (**Tkalcic**);
- **EXERCISE 4** – Basic receiver function inversion for synthetic data using reflectivity method and linearized inversion with the estimation of uncertainties (**Julia**);

4:00-6:00 PM (**Frassetto/Tkalcic**)

- **EXERCISE 5** – H-K method using synthetic data from Exercise 1; time permitting using waveform data from Exercise 2 (**Frassetto**);
- **EXERCISE 6** – (time permitting) Basic receiver function inversion for synthetic data using non-linear Monte Carlo inversion (Neighbourhood Algorithm) (**Tkalcic**)

MONDAY - JANUARY 21

9:00-10:30 AM (**Julia/Pasyanos**)

- Limitation of receiver function methods; Description of surface wave dispersion and software to retrieve dispersion curves from a pre-existing tomography model; Description of joint inversion of receiver functions and surface wave dispersion methods; Overview of software (**Julia/Pasyanos**);

10:45-12:00 AM (**Tkalcic**)

- Continuation of description of joint inversion of receiver functions and surface wave dispersion methods; Beyond the conventional methods: advanced joint inversion of receiver function and surface wave dispersion within the Bayesian inference; Advanced inversion of receiver functions taking into account the Moho dip (**Tkalcic**);

1:30-3:30 PM (**all**)

- Questions & answers regarding Exercises 3-6 (**Tkalcic/Julia/Frassetto**);
- **EXERCISE 7** – Forward modelling of receiver functions and surface wave dispersion using IRFFM2 (**Tkalcic**);
- **EXERCISE 8** – Basic joint receiver function and surface wave dispersion inversion with the estimation of uncertainties using synthetic data from Exercise 1 and the morning lecture dispersion data presented by Pasyanos (**Julia/Pasyanos/Sandvol**);

4:00-6:00 PM (**all**)

- **EXERCISE 9** – Basic joint receiver function and surface wave dispersion inversion with the estimation of uncertainties using waveform data from Exercise 2 and dispersion data presented by Pasyanos (**Julia/Pasyanos**);
- **EXERCISE 10** – (time permitting) Advanced Neighbourhood Algorithm RF inversion including inversion for a dip of Moho (**Tkalcic**);
- **EXERCISE 11** – Joint inversion of receiver function and surface wave dispersion using new data sets from participants' networks. (**all**).

TUESDAY - JANUARY 22

9:00-10:30 AM (**all**)

- Questions & answers regarding Exercises 7-11 (**all**);
- **EXERCISE 11 contd.** – Continue using joint inversion techniques and applying them to new data sets from participants' networks (**all**);
- Work on presentations;

10:45-12:00 AM

- Work on presentations;
-

1:30-3:30 PM

- Participant presentations;

4:00-6:00 PM

- Participant presentations; Questions & answers.