Report Developers Workshop 2016

June 20 - 24, 2016

University of Washington, School of Aquatic and Fisheries Sciences

Seattle, Washington, USA

Contents

<a name="description"/>

Description

This report summarises the events of the 6th ADMB Developer’s Workshop, a meeting held at the University of Washington School of Aquatic and Fisheries Sciences, Seattle Washington. The meeting was attended by many ADMB and TMB core developers who were joined by invited European and American experts.

These experts introduced their software development experiences in similar types of challenges.

The meeting was held in the typical informal style, allowing open group discussions and demonstrations of new features, possible improvements, and current issues. Meeting participants spent considerable time working in sub-groups, each of which tackled a related set of priority issues for the ADMB project.

Participants are included in an appendix to this document. Jim Ianelli chaired the majority of the workshop, with much assistance from Arni Magnusson and Mollie Brooks. Gavin Fay and Johnoel Ancheta along with others acted as rapporteur and compiled and edited this report. An ADMB foundation meeting was held at the conclusion of the workshop and new members and board were appointed.

The workshop was broadcast via the internet to allow for remote participation.

<a name="agenda"/>

Agenda

The main **objectives** of the workshop are

- Plan and develop instructional videos
- Coordinate between TMB and ADMB Projects
- Further develop MCMC implementations
- Review new website design (converted from plone to wordpress)
- Hold an ADMB Foundation meeting

Schedule

The following outlined the agenda and schedule that was followed.

Monday, June 20

Opening and Instructional Videos

Time	Speaker	Activity
9:00AM		Opening: revision and approval of agenda; assignment of repporteurs
10:00AM	Arni Magnusson	ADMB-IDE, rolling out version 11.5, people willing to help out? Also, a quick review of TMB-IDE.
11:00AM	Discussion	
1:00PM		**Lunch**
2:30PM	Mollie Brooks	The glmmTMB package for flexible mixed models in R
3:30AM	Jim Thorson	Progress with spatio-temporal analysis of multivariate (e.g., species or sizes) data using TMB, and how statistical developments might help
4:30PM		Discussion

Time	Speaker	Activity
5:00PM		**End**

Tuesday, June 21

Miscellaneous Topics

Time	Speaker	Activity
9:00AM		Overview of R packages based on ADMB and TMB. Discuss potential new R package, `TMBextras`. Also write up (or find existing write-up?) description of how to create a user-level C++ library.
10:00AM	Chair Hans Skaug	Creation of Instructional videos
11:00AM		Split into breakout groups
Noon		**Lunch**
1:00PM		Breakout groups
2:00-3.00PM		*PLENARY SESSION:* Subgroups report on initial ideas, progress, and goals
3:00-5:00PM		Breakout groups
5:00PM		**End**

Wednesday, June 22

TMB / ADMB Coordination

Time	Speaker	Activity
9:00AM	Johnoel Ancheta	Website: review new WordPress alternative to Plone.
		Breakout groups
1:00PM		**Lunch**
		Breakout groups
5:00PM		**End**

Thursday, June 23

The use of AD in statistical software

Time	Speaker	Title
9:00AM	David Fournier	The use of higher order AD to develop a multinomial like M estimator for the analysis of compositonal data with an application to fisheries management models
10:00AM	Brad Bell	cppad_mixed: A C++ Package for Laplace Approximation of Mixed
11:00AM		Break

Time	Speaker	Title
11:30AM	Bob Carpenter	Implementation and Application of Reverse-Mode Autodiff in Stan
1:00PM		**Lunch**
2:00PM	Kasper Kristensen	TMB: Automatic Differentiation and Laplace Approximation
3:00PM	Cole Monnahan	Hamiltonian Monte Carlo in ADMB and TMB: current status and future directions
4:00PM	Matthew Supernaw	ATL and Higher-Order Reverse Mode AD
5:00PM		**End**

Friday, June 24

Foundation Meeting and Conclusion

Time	Activity
9:00AM	Discussion: How can the TMB and ADMB Projects support one another (Chair Jim Ianelli)
	Outreach
	More training workshops
	Fund raising
	Possible relocation of project
2:00PM	ADMB Foundation Meeting
	Discuss Articles of Incorporation
	Relocation of project
	Election of officers
4:00PM	**End**

<a name="presentations"/>

Presentations

Arni Magnusson's presentations AD Model Builder IDE, TMB-IDE and Virtual TMB.

Jim Thorson's presentation Advancements in spatio-temporal models in TMB.

John Sibert's presentation on approaches to and results of porting at "working" ADMB model and data to TMB.

- A Newbie Ports ADMB to TMB.

On Thursday, the workshop was devoted to a series of presentations on alternative approaches (e.g., Stan) and activities where ADMB/TMB are being actively used.

David Fournier's presentation The use of higher order AD to develop a multinomial like M estimator for the analysis of compositonal data with an application to fisheries management models.

Brad Bell's presentations cppad_mixed: A C++ Package for Laplace Approximation of Mixed **N/A** and The cppad_mixed Capture Example and Speed Test.

Bob Carpenter's presentation Stan a Probalistic Programming Language on Stan implementation and issues.

Kasper Kristensen's presentation Template Model Builder.

Cole Monnahan's presentation Hamiltonian Monte Carlo in ADMB and TMB: current status and future directions.

Matthew Supernaw's presentation ATL and Higher-Order Reverse Mode AD.

Mollie Brooks's presentation glmmTMB package for R

<a name="breakoutgroups"/>

Breakout Group Topics

Breakout group topics were proposed. They were self-organized using a document initiated by Mollie.

Below is a list of topics discussed in the breakout groups:

- ADMB-IDE 11.5
- Instructional videos
- Nvidia GPU
- TMB with GPU
- Cross validation methods
- XSSA demo of Sibert
- glmmTMB Package
- Atomic functions and use of derivatives within the template (e.g., newton raphson's within the template)
- Discuss getting better sparseness detection in ADMB
- Protocol for contributing code
- Website issues
- NUTS algorithm in ADMB

Below is a list other interested topics that can be discussed after the workshop:

- cppad_mixed
- Non-normal RE (rotational Bayes)
- MCMC (Riemann with Langevin updates)
- Debugging demonstration and documentation reference
- Posfun in TMB

- Rank order -1 problem
- 3rd order derivatives
- Get install_github() to do source("install_windows.R") when Windows is detected
- Non-normal RE (rotational Bayes)
- Create TMB page on Wikipedia
- glmmTMB publication planning (discussed later during ISEC)

<a name="discussions"/>

Discussions

For the above items, the following briefly describes activities and progress of the breakout groups. Also, other discussions were noted.

ADMB-IDE

Arni presented the status of ADMB-IDE 11.5 and a sub-group was formed to help with maintenance of this package that is commonly used.

Also, see breakout group discussions ADMB-IDE.

Instructional videos

- An excellent instructional video was developed by Mollie, Hans, and Arni.

Website: review new WordPress alternative to Plone.

The www.admb-project.org site should be moved to a new host site because of the uncertainty of website hosting from NCEAS. The NCEAS affiliation should continue to be acknowledged on the new website. Since most commercial internet web sites do not support Plone and python, Wordpress was chosen to host the website pages.

The workshop reviewed the new website design and developed text describing expanded roles of the Foundation to help support the TMB activities and embrace alternative approaches to software development.

The draft website is at http://admb-project-org.admb-foundation.org/.

Also, see breakout group discussions Website Issues.

<a name="discussionbreakoutgroup"/>

Breakout Groups

Each group presented a brief report on the group's effort.

ADMB-IDE

Arni, Chris Grandin and Johnoel

- Arni provided the dependancy list.

- Started configuring the ide build procedure into the automated builds (buildbot).

Task

- Continue to configure buildbot for ADMB-IDE.

Protocols for contributing R and C++ code

Thorson, Kasper, Gavin, Mollie

- Contributing C++ code
  - Kasper created a function `TMB:::install.contrib` which allows contributed cpp code to be used in a TMB model (see example).
- Contributing R functions
  - Kasper created TMB_contrib_R
  - Contains subdirectories that can be installed using devtools R package installer
  - Examples include:
    - Jim Thorson added TMBdebug
    - TMBAIC has been added to TMBhelper in the TMB_contrib_R directory
    - Gavin worked on TMBphase using example code from Mollie
      - Phasing within an optimizer
      - Function with normal inputs, passed via "...", plus two additional arguments, "phase" and "optimizer"
      - Optimizer by default is nlminb
      - phase is a tagged list where missing elements are populated with a vector of 1s, and non-missing elements are integers, and where the optimizer loops through values of phase while progressively changing map to turn on parameters
      - Function works, needs testing.
      - devtools::install_github("gavinfay/TMBphase")
      - Gavin tested using thetalogistic example.
      - Example usage in Roxygen documentation for TMBphase()
      - Not implemented choice of optimizer yet.

Tasks

- It would be nice to have an elem_prod() C++ function.
- Maybe Cole will add TMBmcmc to TMB_contrib_R, which would entail moving the MCMC code currently in the TMB package into TMBmcmc.

Website issues

John Sibert, Johnoel and Mollie.

Revised frontpage text of draft website at http://admb-project-org.admb-foundation.org/.

Tasks

- Add DTU and Coin-R logos (DTU and Coin-R) to website footer.
- Continue to finalize the website.

Nvidia GPU

- Parallelization: Dave has open CL version of the function minimizer that could be used as an example of how the GPU approach might be beneficial.
- Successfully configured the ADMB linux server for Nvidia GPU development support.
  Kasper tested and ran R numerical functions with the GPU. The results showed speed improvements compared to single core cpu runs.

Task

- Take a look at Dave's GPU code for the minimizer.

TMB with GPU

Gavin Fay's experience using TMB with GPU card is available on the github repository. Also, see GPU timings.

glmmTMB Package

- an underdispersed Poisson-type distribution could be added
- facilitate hurdle models in single function call

Atomic functions and use of derivatives within the template (e.g., newton raphson's within the template)

An example presentation of Atomic functions and use of derivatives within the template (within Kasper's presentation)

Compare gradients

- Matthew's AD example comparing gradients with ADMB and TMB was double checked.
- Anders Nielsen has done gradients comparison checks for TMB and ADMB using the examples. They will be releasing a paper that details the results. For most of the examples, TMB and ADMB are the same. However, the inv_cumd_beta_stable did not produce similar gradients. It was discovered the inv_cumd_beta_stable function in ADMB was incorrect. They already have a fix and will merge into the admb master. A report describing the comparision will be made available.

Sparseness Detection

It was noted that there would be advantages to having sparseness detection built into ADMB as it is with TMB.

Task

- Look into adding sparse detection for ADMB from the TMB code.

Cross validation methods

The topic of model selection approaches (e.g. Cross validation methods, Conditional AIC, 1 step predict) was raised and it was noted that in the directory (see existing example).

TMB Script

John Sibert pointed out that it would be unpleasant to have to learn R just to use TMB. A sub-group endeavored to run cppad_mixed, using cppad without the TMB layer.

Another group led by Jim Ianelli and joint by Anders Nielsen developed a setup based on a simple R-script and shell script (both are intended to be unchanged), which allow the user to run models without ever writing a single line in R. The user need to supply three files: 1) A cpp implementation of the negative log likelihood for the model (.cpp), 2) a data file (.dat), and 3) a parameter initialization file (.pin). The data file and the initialization file names the data objects and the parameters, and the cpp file must match. The keyword RANDOM in the initialization file specified if a given parameter (vector) is to be treated as a random effect. It is important to note that in this setup R is still used, but just made invisible to the user. The code for this setup (script.R and tmbrun) along with two working examples (thetalog and lm) can be found at the github page:

https://github.com/fishfollower/hideR

TMB Users

Created TMB Users google group so that users can answer each other's questions rather than load up the "issues" on the TMB github repository. As of 22 Sept 2016, it has 18 users.

NUTS algorithm in ADMB

Cole Monnahan led discussions about the current state and future directions of Hamiltonian Monte Carlo in both TMB and ADMB. This included the prospect of adding Riemannian HMC and "variational inference." Bob Carpenter noted the difficulties with ADVI, but that RHMC is very promising for models up to hundreds of parameters with very difficult posterior geometries. Thus, the short-term goals are to get NUTS with adaptation of the step size and mass matrix in both TMB/ADMB. The longer term would be to get RHMC updates working with NUTS.

Task

- Cole, Dave and Johnoel will work toward this goal over the next 6 months.

Other Discussions

- Bob Carpenter and Brad Bell led discussions about autodiff in general and announced that there will be a workshop in Oxford (still time to submit a poster abstract).
- Several began planning spatio-temporal textbook using TMB.
- Fix sdreport() for singular hessian cases (avoid crash, just output NaN)
- Now warnings from CHOLMOD during optimization are disabled by default. They can be activated by adding

  ```
  newtonOption(obj,silent=FALSE)
  ```

  However, you will know that they would have been generated if “ustep” is less than one.

<a name="admbfoundation"/>

ADMB Foundation Meeting

Funding

Steve Martell suggested getting funding from the commercial fisheries. They are looking to fund real-time fish tracking tools.

Election

Voted on new members:

- Allan Hicks
- Kasper Kristensen
- James Thorson
- Cole Monnahan
- Gavin Faye

Elected new board member officers:

- President is Arni Magnusson.
- Treasurer is Allan Hicks.
- Secretary is Mollie Brooks.

<a name="accomplishments"/>

Accomplishments

One of the objectives of the workshop is to identify priorities for the projects which include tasks and potential new features.

<a name="priorities"/>

Priorities

Tasks

- Automate ADMB-IDE builds
- Website: Move from NCEAS to another web host
- Documenting the source code
- Website: Add DTU Aqua in footer
- Video: Provide youtube link to instructional video
- ADMB: Merge inv_cumd_beta_stable fixes
- Continue collaboration with TMB, cppad and Stan projects.

Potential new features

- NUTS algorithm into ADMB - Cole
- GPU Parallelization in ADMB code

Collaboration

Anders Nielsen urges to keep maintaining more than one tool for automatic differention.

As the breakout groups have shown, both TMB and ADMB projects (as well as Stan) can benefit from collaboration.

Kasper Kristensen and Anders Nielsen presentation outlines an Example on joint ADMB/TMB development effort.

Rick Methot and Matthew Supernaw were in attendance.

<a name="appendix"/>

Appendix

Notes

- Gavin Fay's workshop notes.

<a name="participants"/>

Participants

Name	Affiliation	Notes
Teresa A'mar	National Oceanic and Atmospheric Administration	
Johnoel Ancheta	ADMB Project, JIMAR, University of Hawaii	
Brad Bell	University of Washington	Developer cppad
Casper Berg	Technical University of Denmark	Developer glmmTMB
Mollie Brooks	University of Zurich	Developer glmmTMB
Bob Carpenter	Stan Project	
Gavin Fay	University of Massachusetts	
Kyle Foreman		
Dave Fournier	Otter Research	
Chris Grandin	Fisheries and Oceans Canada(DFO-MPO)	
Allan Hicks	International Pacific Halibut Commission	
Jim Ianelli	University of Washington	
Kasper Kristensen	Technical University of Denmark	Developer TMB and glmmTMB
Jeff Laake	National Oceanic and Atmospheric Administration	Remote participation

Name	Affiliation	Notes
Arni Magnusson	International Council for the Exploration of the Sea(ICEAS)	Developer TMB
Steve Martell	Sea State Incorporated	
Rick Methot	National Oceanic and Atmospheric Administration	
Cole Monnahan	University of Washington	
Anders Nielsen	Technical University of Denmark	Developer glmmTMB
John Sibert	ADMB Project, JIMAR, University of Hawaii	
Hans Skaug	University of Bergen	
Matthew Supernaw	National Oceanic and Atmospheric Administration	Developer atl
Jim Thorson	University of Washington	
Athol Whitten	Mezo Research	Remote participation