

ACOUSTICS RESEARCH INSTITUTE



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The 3rd AMT Workshop



Turin, 8.9.2023



The AMT Workshop: Structure and Goals

- What is the AMT and how can it be useful for you?
 - General AMT structure
 - The core functionality
 - Basic: Using AMT models
 - Advanced: Make your own model
 - Hands-on in two groups (Basic, Advanced)
- Goals:

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- Do you know what is the AMT and its components?
- Do you have a basic idea of what you can do with the AMT?
- *Basic*: Are you able to install the AMT and run its models?
- *Advanced*: Are you able to implement your own model?



The AMT

- An open-source and open-access toolbox for auditory modeling •
 - A tool for reproducing scientific experiments with auditory models —
 - A framework for developing new models
- **Environment:** •
 - Core: Matlab/Octave _
 - Models: (nearly) any programming language
- Software license:
 - Core: GPL version 3
 - Models: Multi licensing; (nearly) any GPL3-compatible license
- Link of a large amount of data and complex code •
- Integration of other toolboxes useful in auditory research

The AMT

- 2009: Development initiated by Peter Søndergaard
- 2012: Development moved to ÖAW
- 2021: AMT 1.0 released

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- Now: Over 60 auditory models, 40 GB of auditory data
- Two releases per year, with a focus on sustainability
- Community work: Most of the models "donated" to the AMT
- Increase the authors' visibility and add citations





Typical stages of auditory models

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Typical stages of auditory models



- Model ≠ Model implementation
- Models need data

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- Model implementations often rely on toolboxes
- Some models use common functionality, some are stand-alone concepts





- Model ≠ Model implementation
- Models need data

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- Model implementations often rely on toolboxes
- Some models use common functionality, some are stand-alone concepts





• Model ≠ Model implementation: Smith et al. (2022) → smith2022

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- Model ≠ Model implementation: Smith et al. (2022) → smith2022
- Models need data: Auxiliary data

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- Dedicated function: → data_smith2022
- Direct: → amt_load('smith2022',..)





- Model implementations often rely on toolboxes: Third-party toolboxes
 - Large Time Frequency Analysis Toolbox (LTFAT)

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 Optional: Spatially Oriented Format for Acoustics (SOFA) Toolbox, Sound Field Synthesis (SFS) Toolbox, Circular Statistics (CircStat) Toolbox, Binaural Spherical Harmonics (BinSH) Toolbox





• Core functions: the main power of the AMT

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- Storing pre-calculated data: Cache → amt_cache
- Data handling: Auxiliary data → amt load
- Simulation of experiments: → amt_emuexp





• Models

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- → breebaart2011
- Model stages:
 - → breebaart2011_outmiddlefilter
 - → breebaart2011_eicell
 - \rightarrow breebaart2011_centralproc





• Common functions:

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- → scaletodbspl
- \rightarrow erb2fc
- \rightarrow middleearfilter
- \rightarrow gammatone
- \rightarrow itdestimator
- \rightarrow adaptloop





- Demonstrations: Simple scripts demonstrating the functionality
 - \rightarrow demo_smith2022

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Demonstrations

demo_hohmann2002;



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Demonstrations

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demo_chen2011;



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Demonstrations

demo_reijniers2014;



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- Demonstrations: Simple scripts demonstrating the functionality
 → demo smith2022
- Experiments: Functions reproducing published results
 → exp_smith2022('fig3')

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Experiments

Screenshot from Figure 9 (Baumgartner et al., 2014):

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Baumgartner, Majdak, Laback (2014) "Modeling sagittal-plane sound localization", J Acoust Soc Am 136: 791-802

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Experiments

Screenshot from Figure 9 (Baumgartner et al., 2014):

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Output of
exp_baumgartner2014('fig9');



Baumgartner, Majdak, Laback (2014) "Modeling sagittal-plane sound localization", J Acoust Soc Am 136: 791-802



Experiments



Output of

- Blue: Dau et al. (1997)
- Orchid: Osses and Kohlrausch (2021)
- Green: Zilany et al. (2014)
- Maroon: Bruce et al. (2018)
- Red: Verhulst et al. (2015)
- Skyblue: Verhulst et al. (2018)
- Magenta: King et al. (2019)
- Black: Relano-Iborra et al. (2019)







- Code: Files structured in directories
- Special directories:
 - auxdata
 - cache

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- defaults
- mat2doc

• Website: http://amtoolbox.org

THE AUDITORY MODELING TOOLBOX

HOME	DOWNLOAD	CONTRIBUTORS	CITE US	MODELS	DOCUMENTATION	DEVELOPMENT	RESOURCES
Select the	AMT version						

Select the AMT version:

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- 1.5.0 (July 2023). See changes.
- 1.4.0 (May 2023). See changes.
- 1.3.0 (March 2023). See changes.
- 1.2.0 (May 2022). See changes.
- 1.1.0 (Dec 2021). See changes.
- 1.0.0 (May 2021). See changes.
- 0.10.0 (May 2020). See changes.
- 0.9.9 (September 2017). See changes.
- 0.9.8 (June 2017). See changes.
- 0.9.7 (June 2016)
- 0.9.6 (June 2014)
- 0.9.5 (March 2014)
- 0.9.2 (October 2013)

Bug or typo?

If you think you have found a bug in the code or a typo in the documentation, check out the bug tracker and input the description of the issue you have found. The bug tracker contains a list of all current issues within the AMT and all feature requests for the future.



• Website: http://amtoolbox.org

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THE AUDITORY MODELING TOOLBOX

HOME	DOWNLOAD	CONTRIBUTORS	CITE US	MODELS	DOCU	MENTATION	DEVELOPMENT	RESOURCES
Applies to ver	rsion: 1.5.0							
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Categories	
Main	>
Core functions	>
Models	>
Model stages	>
Demos	>
Experiments	>
Common functions	>
Plot	>
Signals	>
Data	>
Auxdata	>

AMT - Online documentation

General

This is the most complete, and up-to-date description of the AMT. This documentation is directly included in the M-files and it is auto-generated for this website. Because of the automatic generation, the appearance on the website may suffer some details. Note that the current status of the models can be found in the section Models at this website.

New to the AMT?

Download the AMT full package, which provides all third-party toolboxes, start the AMT with amt_start and compile the binaries with amt_mex. To stop the session, use amt_stop which removes the added paths and resets the configuration.

Note that the installation can be also done by calling amt_start('install'), which downloads the third-party toolboxes (if missing) and triggers compilation of the binaries.

Important files in the AMT base path:



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AMT - Core functions

Installation and session management

- amt_mex Compile binaries (Mex/Oct interfaces)
- amt_stop Stop the AMT session and remove all AMT paths

General functions

- amt_cache Cache variables for later or retrieves variables from cache
- amt_disp AMT-specific overload of the function 'disp'
- amt_emuexp Emulate psychoacoustic experiments
- amt_flags Return the start-up flags of the AMT
- amt_load Load auxiliary data of a model
- amt_extern Execute functions in an external environment (e.g., Python)

Paths and configuration

• amt_configuration - Return the configuration of the AMT



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AMT_CONFIGURATION - Get and set the configuration of the current AMT session

Usage:

[flags, kv] = amt_configuration; [flags, kv] = amt_configuration('cacheURL', cU); [flags, kv] = amt_configuration('silent'); [flags, kv] = amt_configuration('silent', 'normal');

Description:

amt_configuration accepts the following optional parameters:

'cacheURL', *cU* Set the download URL of the cache 'auxdatapath', *aP* Set the path where the auxdata is stored 'auxdataURL', *aU* Set the download URL for the auxdata



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Applies to ver	rsion: 1.5.0						
View th	ne help				Go to function	amt_configuration	~



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AMT_CONFIGURATION - Get and set the configuration of the current AMT session

Program code:

%A/	MT_CONFIGURATION Get and set the configuration of the current AMT session
%	
%	Usage :
%	[flags, kv] = amt_configuration;
%	<pre>[flags, kv] = amt_configuration('cacheURL', cU);</pre>
%	[flags, kv] = amt_configuration('silent');
%	<pre>[flags, kv] = amt_configuration('silent', 'normal');</pre>
%	
¥	AMT_CONFIGURATION accepts the following optional parameters:
%	
%	'cacheURL'.cll Set the download URL of the cache

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Documentation

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🗉 💄 common 🔹 🔹	[flags, kv] = amt_configuration;	
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🗉 📕 data 🔹	[flags, kv] = amt_configuration('silent');	
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modelstages	`amt configuration` accepts the following flags:	
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gitignore	- cached	['asdasdd'



- Website: http://amtoolbox.org
 - Compiled version: the website
 - Code version

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- In-code documentation
 - Syntax: Similar to reStructuredText
 - Compiler: Based on mat2doc
 - Automatic creation of figures and results
 - Links to the publications

Categories Core functions

Main

Models

Demos

Plot Signals

Data

Auxdata Cache

See also

tabuchi2016

Model stages

Common functions

EXP_TABUCHI2016 - Results from Tabuchi et al. (2016)

.

-

Usage:

data = exp_tabuchi2016(flag)

Description:

exp_tabuchi2016(flag) reproduces figures of the study from Tabuchi et al. (2016).

The following flags can be specified

'fig6' Reproduces the lower panel of Figure 6

Examples:





References:

H. Tabuchi, B. Laback, T. Necciari, and P. Majdak. The role of compression in the simultaneous masker phase effect. The Journal of the Acoustical Society of America, 140(4), 2016. [DOI]



EXP_TABUCHI2016 - Results from Tabuchi et al. (2016)

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Program code:

<pre>function varargout = exp_tabuchi2016(varargin)</pre>
%EXP_TABUCHI2016 Results from Tabuchi et al. (2016)
<pre>% Usage: data = exp_tabuchi2016(fLag)</pre>
*
% EXP_TABUCHI2016(flag) reproduces figures of the study from
% Tabuchi et al. (2016).
×
% The following flags can be specified
X
% 'fig6' Reproduces the lower panel of Figure 6
%
% Examples:
×
X
% To display Fig.6 use :
X
% exp_tabuchi2016('fig6');
×
% See also: tabuchi2016
% References:
% H. Tabuchi, B. Laback, T. Necciari, and P. Majdak. The role of
% compression in the simultaneous masker phase effect. The Journal of the
% Acoustical Society of America, 140(4), 2016.
% Url: http://amtoolbox.org/amt-1.5.0/doc/experiments/exp_tabuchi2016.php
8 Hauthan Ulasshi Tahushi (2022)
* #Author: Hisdaki Tabuchi (2022)
<pre>% #Author: Clara Hollomey (2023): daaptations for AMI % #Author: Joanna Cucusana (2023): implemented plating</pre>
» #Author: Joonas Guevara (2023): implementea ploting
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definnut flags type = { 'missingflag' 'fig6'}
active and a contraction of a contractio
<pre>[flags,~] = ltfatarghelper({},definput,varargin);</pre>



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Documentation

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Models included in the AMT (latest release, 1.5.0)

In order to describe the quality of the models available in the AMT, we rate the implementation of every model by considering its **source code** and **documentation**. We also rate the models in terms of their **verification**, i.e., we rate the results of the implementation versus the results shown in the corresponding publication. The comparison is done within the experiments implemented in the exp_ functions. In the best case, the experiments produce the same results as in the publication - up to some minor layout issues in the graphical representations.

The following table provides an overview of the available models, their documentation, code, and verification status.

Peripheral models	Function	Doc	Code	Verification
Gammatone filterbank	gammatone	~	~	×
Linear filtering for monaural masking (basic)	dau1996	0	~	?
Linear filtering for monaural masking (improved)	dau1997	0	*	?
Invertible Gammatone filterbank	hohmann2002	~	~	~
Dual-resonance nonlinear filterbank (DRNL)	lopezpoveda2001	~	~	~
Fast acting compression (CAREAC) model	lvon2011			2



- Website: http://amtoolbox.org
 - Compiled version: the website
 - Code version

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- In-code documentation
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 - Syntax: Similar to reStructuredText
 - Automatic creation of figures and results
 - Links to the publications
- Model list and ratings
- Other resources



Getting started

• The release package:

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- For **working** with the AMT only
- Download the full release package from Sourceforge
- Starting the AMT:
 - Go to the AMT directory
 - Start the AMT: amt_start;
 - Compile the environments: amt_mex;
- Testing the environment:
 - Simple test: demo_absolutethreshold
 - SOFA/auxdata/internet test: demo_baumgartner2014
 - C-compiler test: demo_zilany2014
 - **Python test:** demo_verhulst2012
- Stopping the AMT: amt_stop;
- Cheat sheet: http://amtoolbox.org