AToM

ANTENNA TOOLBOX FOR MATLAB

DEPARTMENT OF ELECTROMAGNETIC FIELD
CZECH TECHNICAL UNIVERSITY IN PRAGUE
CZECH REPUBLIC

Antenna Toolbox for Matlab (AToM)

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[1] Czech Technical University in Prague, [2] Brno University of Technology, [3] MECAS ESI s.r.o.
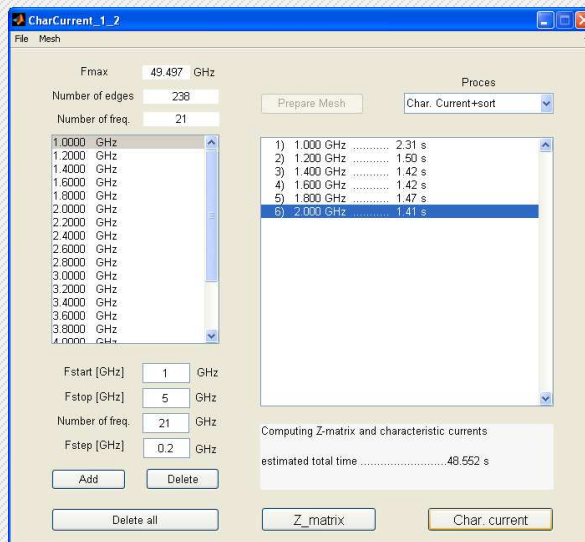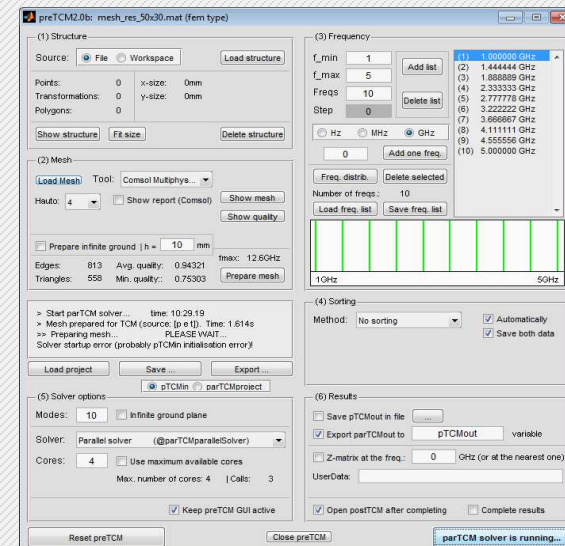
viktor.adler@antennatoolbox.com

History of the toolbox

- 2008: First software for Method of Moments + Characteristic Modes developed (master thesis of Pavel Hamouz)
- since 2009: Further work within the Ph.D. study of Miloslav Capek and Jan Eichler

2008 version

2014 version

Tools for Synthesis of Antennas and Sensors

Project details

- supported by Technology Agency of the Czech Republic (TA ČR)
  - ALFA programme (applied research, experimental development, technologies)
  - time of development: 07/2014 - 12/2017
  - approx. 600 k€

- 3 participants
  - CTU in Prague and BUT - AToM and FOPS (Matlab)
  - MECAS ESI s.r.o. - Visual Antenna (CEM One)
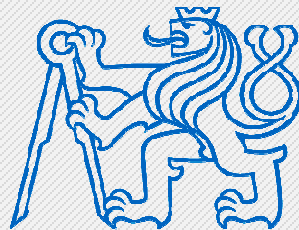
Tools for Synthesis of Antennas and Sensors

Project details

- project's staff
  - Miloslav Capek, Viktor Adler, Milos Mazanek, Pavel Hazdra, Petr Kadlec, Vladimir Sedenka, Zbynek Raida, Jaroslav Rymus


- students
  - Vit Losenicky, Michal Masek, Miroslav Cupal, Martin Marek, Martin Strambach

AToM → Visual Antenna

- The key functionality of the AToM will be implemented into Visual Antenna package, developed by MECAS ESI company.
- Visual Antenna is a module for CEM One, which integrates simulation tools for Computational Electromagnetics developer and distributed worldwide by ESI Group
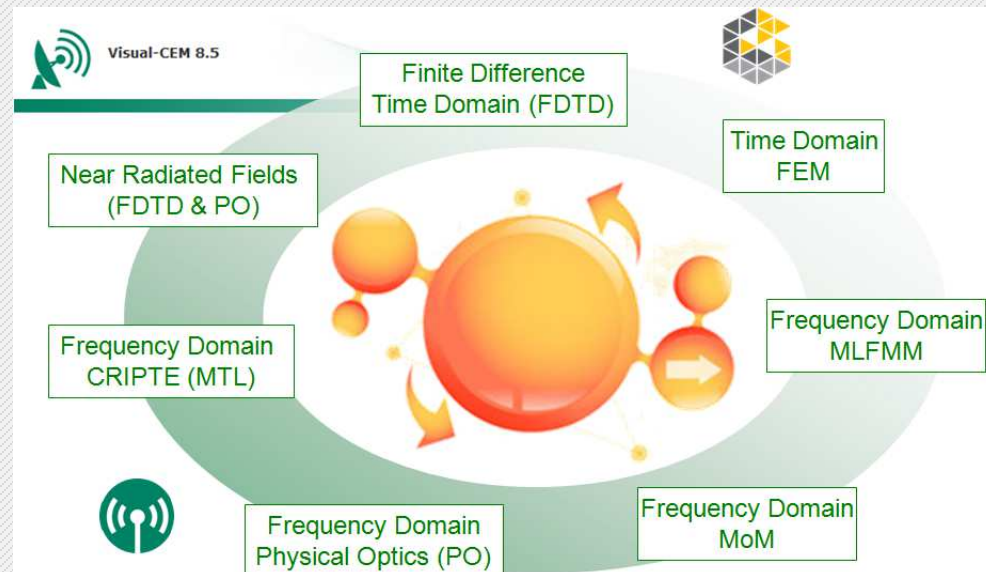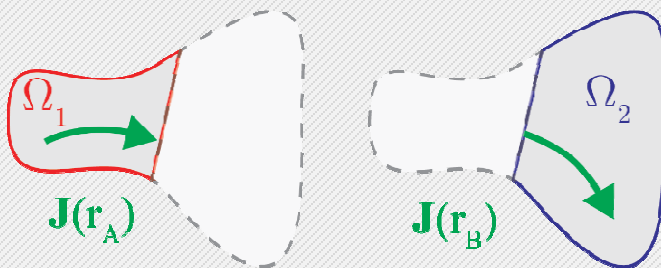
Antenna Toolbox for Matlab
Main features

- method of moments for 3D planar and wire structures
- characteristic mode decomposition with robust tracking
- adaptive frequency sweep
- accept other codes from the community - semiopen MATLAB architecture
- handle with data from third party software
- utilization of the *source concept → antenna can be completely described by its geometry and current density*
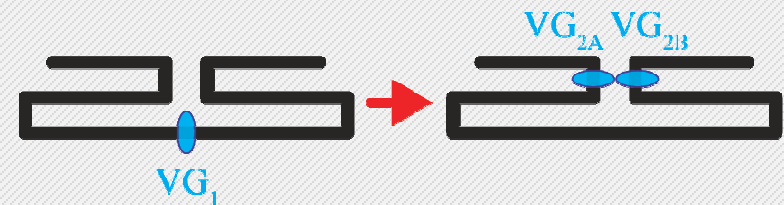
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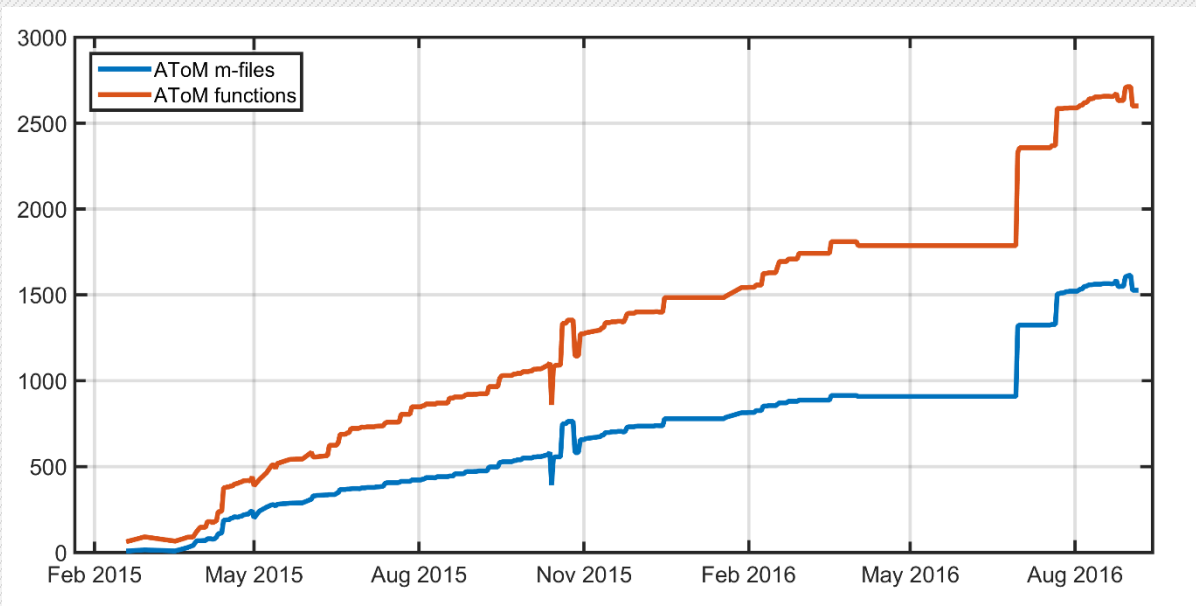

Structural decomposition

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Structural decomposition

Feeding synthesis

Antenna Toolbox for Matlab
Present state

- data analyzed daily at GIT server by Jenkins

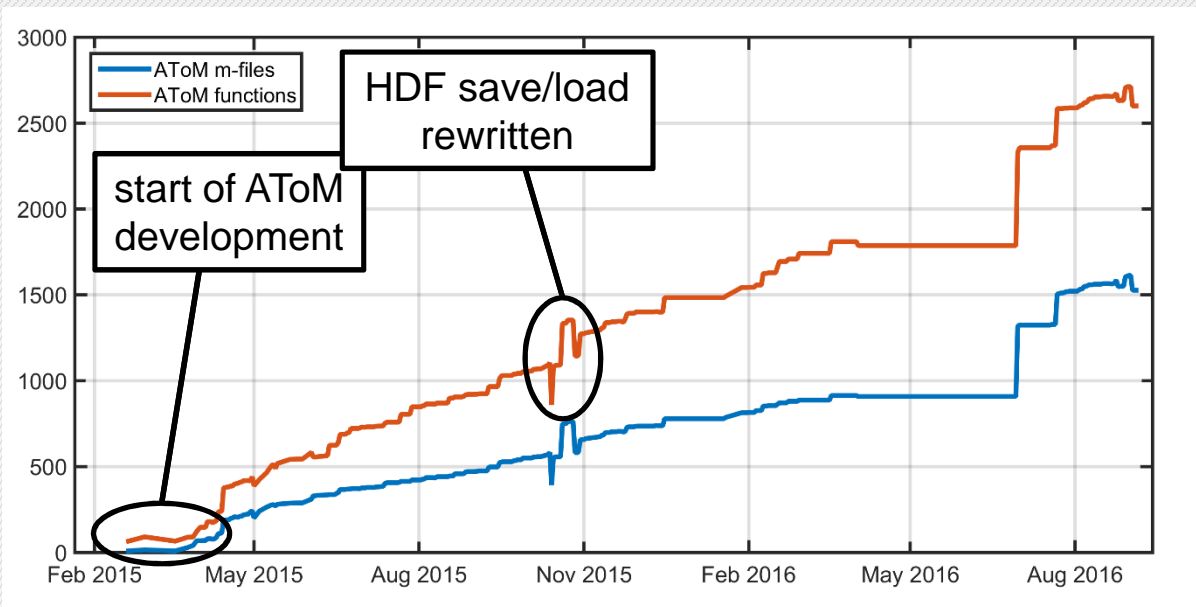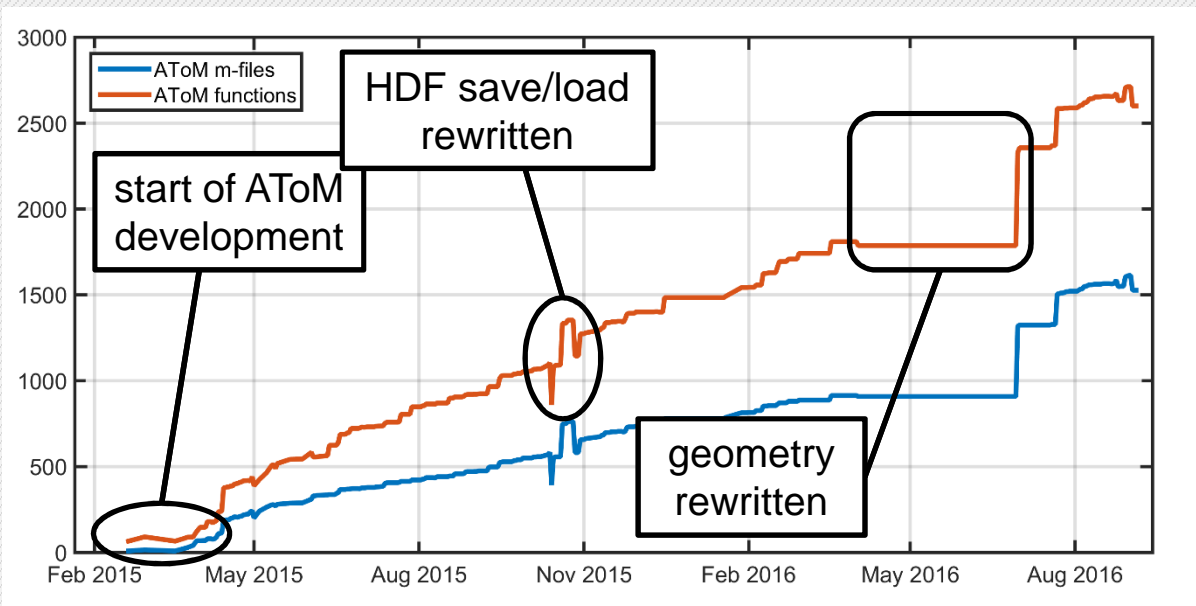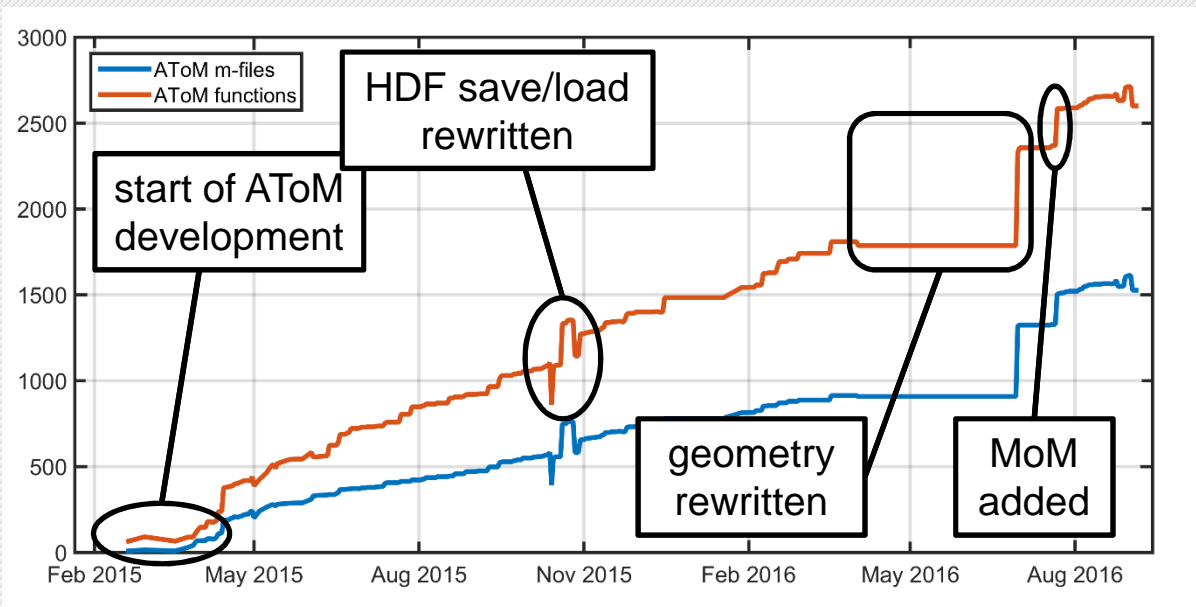| classes	197
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unit tests	1224
lines of code	98106
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Valid on 05/09/2016.

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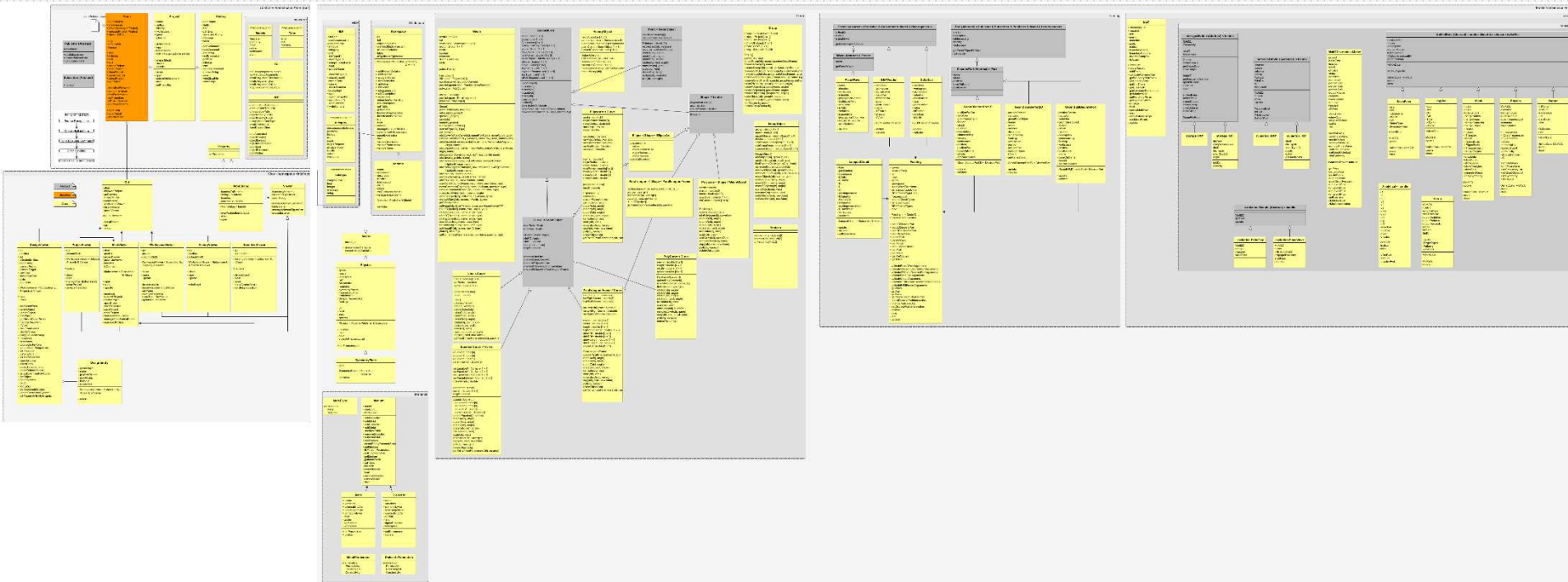- data analyzed daily at GIT server by Jenkins

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Antenna Toolbox for Matlab
UML scheme at 04/2016

Antenna Toolbox for Matlab
Project infrastructure

- tending to agile development
- MECAS ESI s.r.o. server in Pilsen
  - GIT - version control system
  - web server (www.antennatoolbox.com)
  - email server (user@antennatoolbox.com)
  - ftp

Antenna Toolbox for Matlab
Project infrastructure

- CTU server in Prague
  - Jenkins - continuous integration system
  - Unit Test Framework
  - analyze whole code once a day
  - iceScrum (SCRUM)
  - results are saved to ftp
  - sending emails to sinners

Antenna Toolbox for Matlab
Main classes

- Atom
  - singleton pattern utilized
  - management of projects
  - handling with preferences

- Project
  - contain references to all models
  - practically no functionality

- HDF
  - data storage
  - Hierarchical Data Format
  - suitable for recording and recovering computer data of electromagnetic simulations

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```
atom = Atom.start;
atom.createProject('myProject');
atom.selectedProject.save;
atom.closeProject('myProject');
atom.openProject('myProject');
atom.quit;
```

Antenna Toolbox for Matlab
Main classes

- History
  - all actions in AToM are captured
  - overloaded `subsref` of Project
  - actions can be evaluated as batch

- Workspace
  - using variables through AToM
  - arbitrary complex expressions
  - calling external functions from AToM
  - observer pattern utilized

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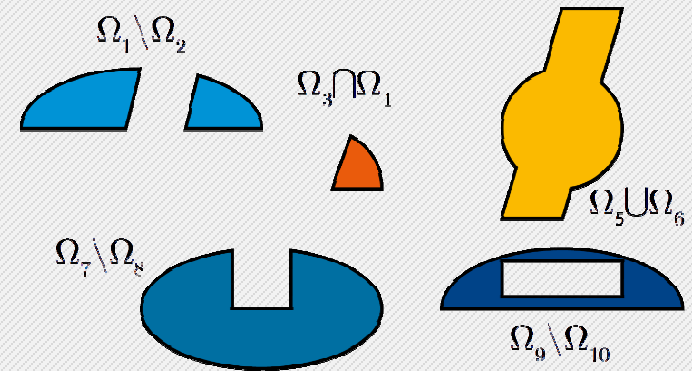 - calling external functions from AToM
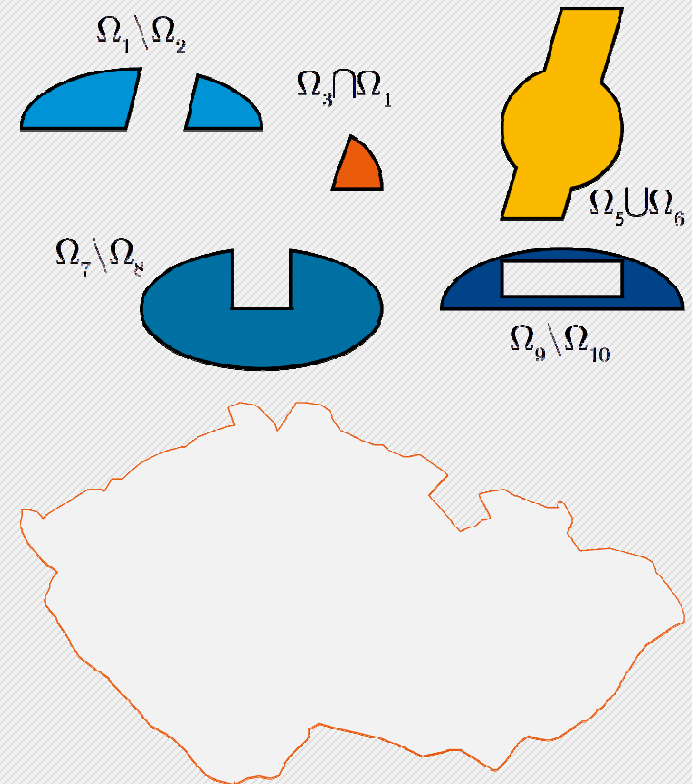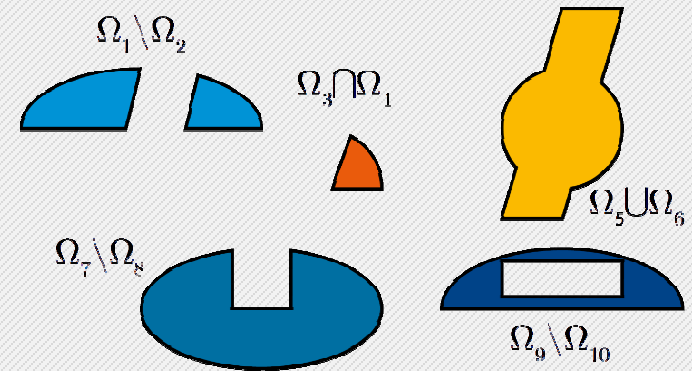 - observer pattern utilized

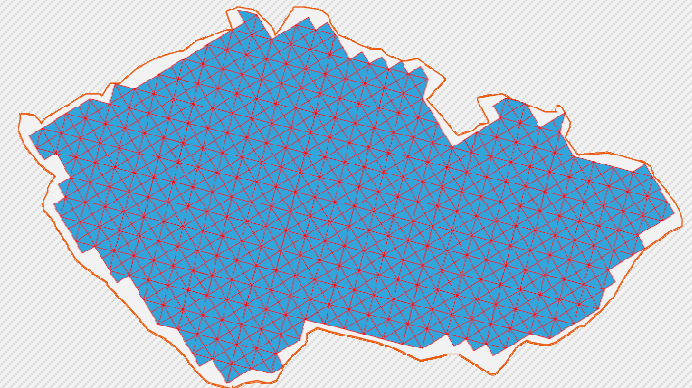# Antenna Toolbox for Matlab
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  - definition of geometry primitives
  - transformations, boolean operations
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- Mesh
  - creation of deterministic mesh from geometry
  - using DistMesh - P. O. Persson
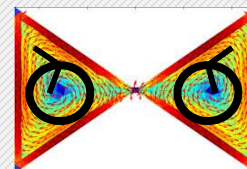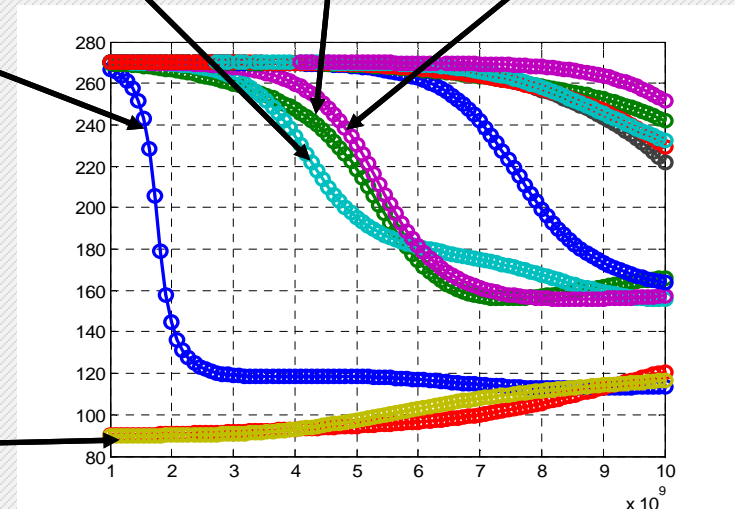 - fix points and fix edges

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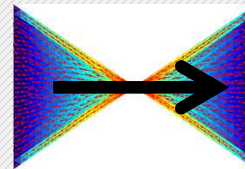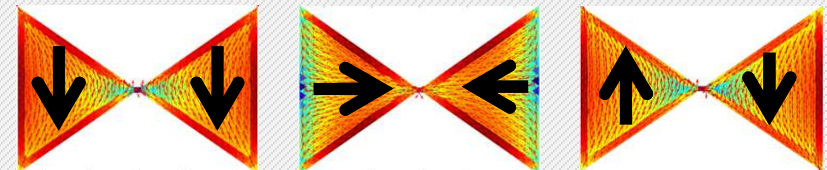 - fix points and fix edges

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Antenna Toolbox for Matlab
Main classes

- Physics
  - physical parameters of design
  - frequency list
  - feeding
  - symmetry planes
  - boundary conditions

- Solvers
  - MoM (Method of Moments) 1D and 2D
  - GEP (General Eigenvalue Problem)
  - BEM (Boundary Elements Method)

Antenna Toolbox for Matlab
GUI

- Observer pattern utilized

Antenna Toolbox for Matlab
## Utilized Matlab features

- Object-Oriented Programming
  - vectorized OOP
  - heterogeneous classes

- Unit Test Framework
  - Class-Based Unit Tests

- Source Control Integration
  - GIT

- Code Performance
  - profiling via `profile`
  - profile coverage

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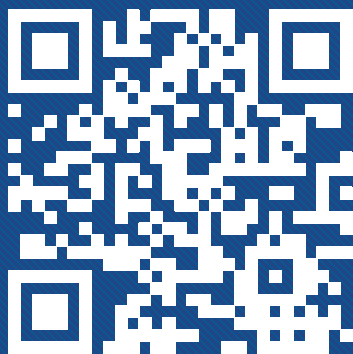- Code Performance
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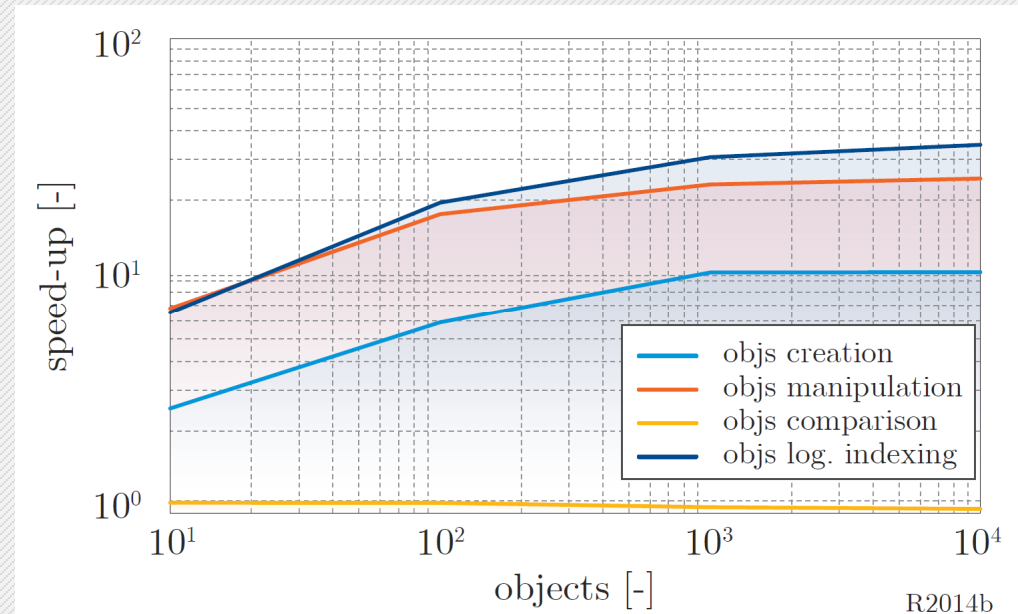
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FOR YOUR ATTENTION

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viktor.adler@antennatoolbox.com

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