PIETOOLS_2021a: Troubleshooting

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PIETOOLS 2021a is a MATLAB toolbox used for manipulation of Partial Integral (PI) operators and solving optimization problems involving PI operators, referred to as Linear PI Inequality problems (LPIs).

1 Installing PIETOOLS 2021a

In this section, we discuss the installation and setting up of PIETOOLS 2021a. Additionally, we discuss some common issues users may run into while installing. Currently, the toolbox is compatible with Windows, Mac or Linux systems and has been verified to work with MATLAB version 2014 or higher. Nevertheless, we highly recommend using the latest version of MATLAB.

PIETOOLS 2021a can be installed either using the install script, or manually:

Setting up PIETOOLS 2021a using the install script

To install PIETOOLS in this way:

- Go to the website control.asu.edu/pietools/.

- Download the file pietools_install.m and run it in MATLAB.

- Run the script **from the folder it is downloaded in** to avoid path issues.

The script installs the following files:

   i. tbxmanager (skipped if already installed),

  ii. SeDuMi 1.3 (skipped if already installed),

 iii. Modified SOSTOOLS 3.03 (always installed),

  iv. PIETOOLS 2021a (always installed).

It also adds all the files to your MATLAB path.

Setting up PIETOOLS 2021a manually

To set up PIETOOLS manually:

- Download and install C/C++ compiler for the OS.

- Download SeDuMi and run the **install_sedumi.m** file.

  - Alternatively, install MOSEK and add to your MATLAB path.

- Download the zip file **PIETOOLS_2021a.zip** (from control.asu.edu/pietools/).

- Extract the zip file and add it to your MATLAB path.

1.1   Troubleshooting: Installation

When installing the PIETOOLS toolbox using the install script, in rare circumstances, the user may run into one of following errors. In case of an error, a message is displayed explaining the issue, which can be one of the following.

1. *An error appeared when trying to create the folder ...*
   Check if the folder already has a folder named **PIETOOLS_2021a**. If that does not resolve the issue try running MATLAB from an administrator account which has the authority to create or modify folders. As a last resort, try installing in a different folder. If that does not fix this, contact us.

2. *The installation directory " " already exists...*
   Obvious error. However, if there is no folder with the name PIETOOLS_2021a, check for a hidden folder.

3. *'tbxmanager' or 'SeDuMi' were not downloaded or installed...*
   Check your internet connection. Verify that MATLAB is allowed to download files using the internet connection. Check if the websites for tbxmanager and SeDuMi are operational.

4. *'PIETOOLS' was not downloaded or installed...*
   Check the suggestions for the previous error. If that does not fix the issue, contact us.

5. *Could not modify the initialization file "startup.m"...*
   Try running MATLAB from an administrator account which has the authority to create or modify folders. If that does not fix the issue, manually add SeDuMi or the relevant SDP solver (like MOSEK, sdpt3, sdpnal) to your MATLAB path, and extract the files in **PIETOOLS_2021a.zip**. Also add PIETOOLS to your MATLAB path.

6. *Could not save the path to a default location...*
   Try running MATLAB from an administrator account which has the authority to create or modify folders. If that does not fix it, just add PIETOOLS and SeDuMi to your MATLAB path and skip this step.

1.2 Troubleshooting: Solving LPIs

PIETOOLS can be used for solving LPI optimization problems and users may run into errors while setting up and solving them. For any errors in setting up an LPI, refer to the function and script headers to ensure that input-output formats are correct. Ensure that PI objects, defined in the LPI problem, are well-defined and valid PI operators. You can use the `isvalid` function to check if a PI operator is well defined. If that does not fix the problem, feel free to contact us.

PIETOOLS 2021a relies on (a modified version of) SOSTOOLS 3.03 with solver SeDuMi to solve optimization problems. If you are unfamiliar with SOSTOOLS, and are unsure how to intepret the results of a solved optimization problem, please check the SOSTOOLS manual available at http://www.cds.caltech.edu/sostools/, or the SeDuMi manual avaialable at https://sedumi.ie.lehigh.edu/?page_id=58 for more information. A brief overview of how to interpret results, and what to do in case of error, is provided below:

1. **How do I interpret the results of a solved optimization problem?**
   A general rule of thumb is to look at: pinf, dinf, feasratio and Residual norm. pinf and dinf should be 0, while feasratio is in between -1 and 1 (preferably closer to 1). The lower the residual norm the better. Refer to SeDuMi manual to interpret other output parameters and more details.

2. **What if pinf is 1?**
   Verify if the LPI constraints are in fact feasible. Verify if the sign-definiteness of the PI operator is on a compact interval (use psatz term if local sign-definite is needed) or the entire real line. Use 'getdeg' function to check if your LPI constraint has high degree polynomials. If yes, make sure that all opvar variables used in lpi_eq function have high enough degrees to match it. If this does not resolve the issue contact us and attach the files that you are trying to run along with a snapshot of the error/output.

3. **What if dinf is 1 and feasratio is -1?**
   This issue typically occurs when the objective function is unbounded from below and becomes $-\infty$. Check if the objective function is bounded below. If this does not resolve the issue contact us by email and attach the files that you are trying to run along with a snapshot of the error/output.

2 Contact Details

To resolve issues, report bugs or to collaborate on any development work regarding PIETOOLS, please contact us through email and we will get back to you as quickly as possible. In case of issues with installation, solving problems or bugs identified, please include the script file that generates the error along with images of the error generated in MATLAB. You can reach us through email at: sshivak8@asu.edu, ad2079@cam.ac.uk, djagt@asu.edu and mpeet@asu.edu