

# **A GUIDE TO USE NET\_DIFF**

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# 1 General

Net\_Diff is a software for GNSS Download, Positioning and Analysis.

It supports functions of SPP/PPP/DSPP/DPPP/RTK, it can also applied in SPP/PPP with BeiDou augmentation information.

It supports data analysis, including coordinate plotting, satellite number, PDOP, satellite skyview, satellite number, omc, positioning residuals and so on.

It provides IGS data and products download.

It also provides some useful tools such as time and coordinate system transfer, RINEX edit.

The software is available on GitHub: [https://github.com/YizeZhang/Net\\_Diff](https://github.com/YizeZhang/Net_Diff). You can find the latest version on the website.

## **New features of v1.1:**

1. Modify long baseline RTK;
2. More robust RTK under urban environment;
3. Add Time and Coordinate transfer tool;
4. Add RINEX edit tool;
5. Support command line input for better batch process;

## **New features of v1.2:**

1. Support tightly combined GNSS RTK;
2. Add .pos file output for RTKPLOT;

## **New features of v1.3:**

1. Support GLONASS AR in GNSS RTK;
2. Add Android raw data convert to RINEX tool;

# 2 How to Install

After you download files from GitHub, please follow the steps to install Net\_Diff.

1 Click **gzip-1.3.12-1-setup.exe** and install gzip. For example, after install it, gzip.exe is under C:\Program Files (x86)\GnuWin32\bin\

2

a) If you have installed MATLAB R2017a or MATLAB Runtime version 9.2 (R2017a) in your

computer.

Open /for\_redistribution\_files\_only/ and click **Net\_Diff.exe**

b) If not.

Open /for\_redistribution/ and click **Net\_Diff\_Installer\_web.exe** to install MATLAB Runtime and Net\_Diff. Please keep your computer connected to internet while installing. It will take a few minutes to download MATLAB Runtime, please be patient.

After finish installing, you can find the execute file from the installed program directory, like C:\Program Files\Net\_Diff\application\. If your Windows OS is under C:\, Net\_Diff may can't read and write files under C:\. In this case, it is recommended to copy C:\Program Files\Net\_Diff\application\ to other disk.

3 Copy C:\Program Files (x86)\GnuWin32\bin\**gzip.exe** to the folder of Net\_Diff.

### 3 How to Run

After install the software properly, you can start to run it.

Click **Net\_Diff.exe**, a dos-like window will appear, then after a few seconds, the main GUI of Net\_Diff will show as below.

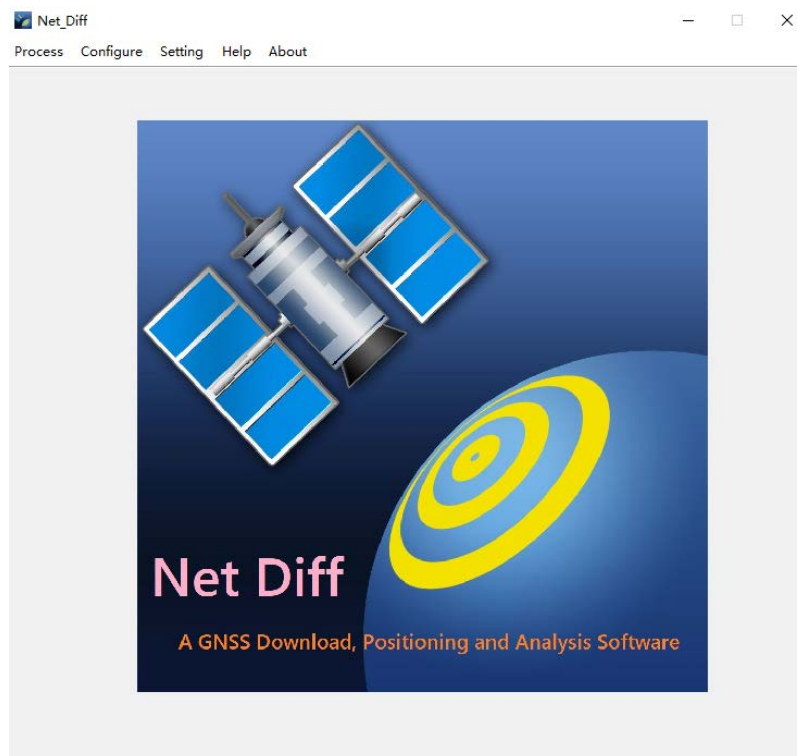
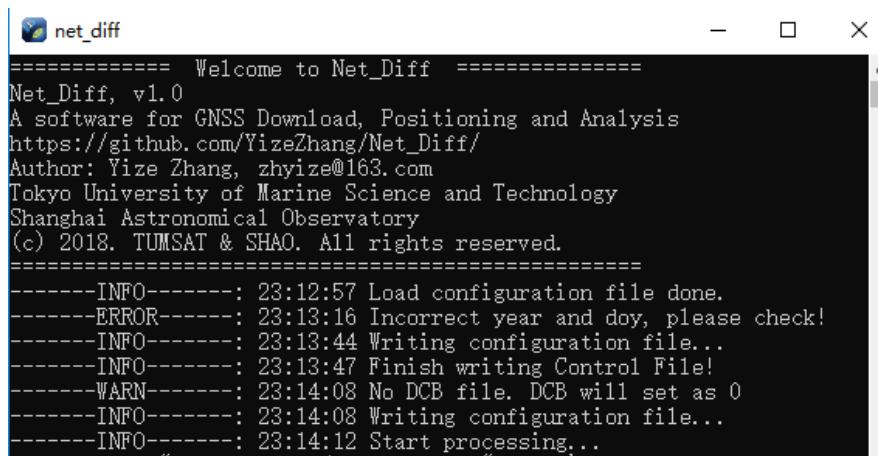


Fig. 1 Main GUI of Net\_Diff

The dos-like widow is also the processing status window. It gives you the information of the software processing status information.

Generally, the information can be divided into 3 kinds, i.e. INFO, WARN, ERROR. INFO just tells

you the action you did in the software. WARN is a warning information of the when you use this software. It is not a severe problem. ERROR is the error information, which is a big issue and will certainly affect your positioning result if you don't handle it properly. Only after you solve the errors, you can get best positioning results.



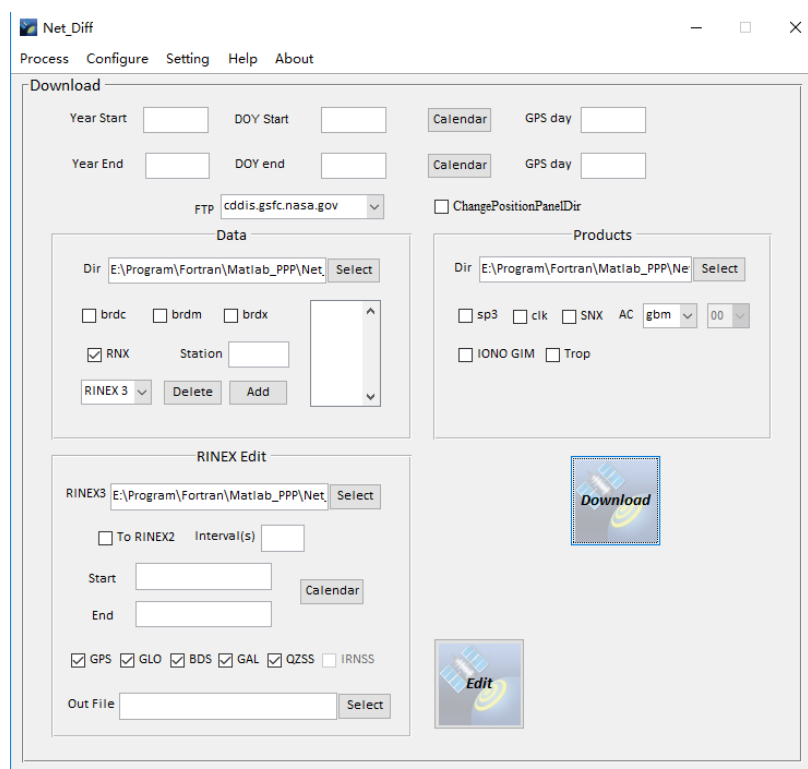
```

===== Welcome to Net_Diff =====
Net_Diff, v1.0
A software for GNSS Download, Positioning and Analysis
https://github.com/YizeZhang/Net_Diff/
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Shanghai Astronomical Observatory
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=====
-----INFO-----: 23:12:57 Load configuration file done.
-----ERROR-----: 23:13:16 Incorrect year and doy, please check!
-----INFO-----: 23:13:44 Writing configuration file...
-----INFO-----: 23:13:47 Finish writing Control File!
-----WARN-----: 23:14:08 No DCB file. DCB will set as 0
-----INFO-----: 23:14:08 Writing configuration file...
-----INFO-----: 23:14:12 Start processing...
  
```

Fig. 2 INFO, WARN and ERROR information in processing status window

## 3.1 Download

Click **Process** → **Download** or **Ctrl+D** to change to download page.



The screenshot shows the 'Net\_Diff' application window with the 'Download' tab selected. The interface includes several sections for configuring data and product downloads:

- Download Section:** Contains input fields for 'Year Start', 'DOY Start', 'Year End', and 'DOY end', each with a 'Calendar' button. There are also 'GPS day' input fields. An FTP address is set to 'cddis.gsfc.nasa.gov'.
- Data Section:** Includes a 'Dir' field with a 'Select' button. Below it are checkboxes for 'brdc', 'brdm', 'brdx', and 'RNK' (which is checked). There is a 'Station' input field and a list box. Buttons for 'RINEX 3', 'Delete', and 'Add' are present.
- Products Section:** Includes a 'Dir' field with a 'Select' button. Below it are checkboxes for 'sp3', 'clk', 'SNX', 'AC', 'gbm', and 'Trop'. There are also input fields for '00' and '00'.
- RINEX Edit Section:** Includes a 'RINEX3' field with a 'Select' button. There is a checkbox for 'To RINEX2' and an 'Interval(s)' input field. 'Start' and 'End' input fields with 'Calendar' buttons are present. Checkboxes for 'GPS', 'GLO', 'BDS', 'GAL', 'QZSS', and 'IRNSS' are shown, with 'GPS' and 'QZSS' checked. An 'Out File' field with a 'Select' button is at the bottom.

At the bottom right, there are two large buttons: 'Download' and 'Edit'.

Fig. 3 Download Page

In this page, you can download the IGS data and products you want.

Please check the hint information on each uicontrol to know their functions.

What should be noticed is that:

- (1) When download IGS observation data, the station name is a four-character name. Although the file name of RINEX 3 has adopts the long name format, the software will transform it into a RINEX 2-like file name.
- (2) When download IGS final clock, although the clock file name is end up with .clk\_30s, the software will delete \_30s and rename it as .clk. This is to unify the file name of all clock products.
- (3) Please keep in mind that you have install gzip and have copy gzip.exe to the same folder of Net\_Diff.exe, otherwise Net\_Diff would not uncompress the downloaded file.
- (4) If you check **ChangePositionPanelDir**, and change to **Positioning panel** from **Download panel**, the directory of observation data, orbit, clock and output would also change to the same directory of products and data in **Download panel**.
- (5) In the **RINEX Edit panel**, only RINEX 3.XX format is supported.

## 3.2 Positioning

Click **Process** → **Positioning** or **Ctrl+P** to change to positioning page.

The screenshot shows the 'Net\_Diff' application window with the 'Positioning' tab selected. The interface is organized into four main panels:

- Setting:** Contains fields for 'Year', 'DOY', 'Calendar', and 'GPST: 0000'. It also has 'Start' and 'End' time pickers. Under 'Obs Type', 'RINEX' is selected with a directory 'E:\data\2018\'. 'Orbit' is set to 'SP3' and 'Clock' to 'CLK', both pointing to 'E:\gbm\gbm'. 'Interval(s)' is 30, 'Elevation Lim' is 10, 'SNR Lim' is 0, and 'Max PDOP' is 20. A 'Download' button is present.
- File:** Lists various input files with 'Select' and 'Update' buttons: 'EOP File' (Input\EOP.txt), 'Ant File' (Input\igs14\_2017.atx), 'GLO&Leap' (Input\GLOFre.txt), 'Iono Type' (GIM, E:\Program\Fortra), 'PIC1 DCB' (Input\PIC11805.DCB), 'GNSS BSX' (E:\data\dcbl), and 'OutputDir' (E:\data\2018\).
- Model:** Includes 'Troposphere' (GPT2...), 'Wet Delay(s)' (7200), and checkboxes for 'GPS', 'GLONASS', 'BDS', 'GAL', 'QZSS', and 'IRNSS'. It also has 'Pos State' (S), 'Frequency' (L1L2), 'Mode' (SPP/PPP), 'Observation' (Code+P...), 'Estimation' (KF), 'Combination' (Iono-Fr...), 'CycleSlip' (GF, MW, LL, P1L1, DD), 'CPD Noise (m)' (1, 0.01, 0.1), and 'Smooth' (No, CNMC, 300 sec).
- Coordinate:** Features 'Rover' and 'Base' coordinates (XYZ, 0.000, 0.000, 0.000) and buttons for 'DownRNX', 'SINEX', 'Header', 'PPP', 'Sat. Health', 'SPP Temp.', 'PPP Temp.', 'RTK Temp.', 'Write', and a highlighted 'Wt. & RUN' button.

Fig. 4 Positioning Page

In this page, you can set your settings for positioning.

An easier way to start positioning is use positioning template firstly. When click pushbutton **SPP Temp**, it provides a basic SPP template. When click pushbutton **PPP Temp**, it provides a basic PPP

template. When click pushbutton **RTK Temp**, it provides a basic RTK template. Based on the template, you can change the settings according to your own requirement.

There are some regulations or points when you change the settings:

- (1) The **Start time** and **End time** should strictly follow the format like: 2017-06-07 00:00:00. It is a 19-character string.
- (2) As mentioned above, the name of RINEX observation file strictly follows RINEX 2. So if you are using the long-name RINEX 3 file or from your own receiver, please change the file name following the format of RINEX 2.11.
- (3) When processing RTK or DSPP/DPPP, the file of rover station and base station should under the same observation file directory.
- (4) The default **observation file type** is RINEX. If you choose X71\_I, X71\_Q, or X11, you should have these types of data. If you don't have, please ignore them and don't choose these types.
- (5) When the **Orbit** or **Clock** type is SP3 or CLK, please add IGS ACs name after the file directory. For example, your sp3 file is E:\products\igs20000.sp3, please make sure that the file directory is E:\products\igs. In fact, when you change **Orbit** or **Clock** type from broadcast to SP3 or CLK, or then select a directory using **Select** pushbutton, the directory will automatically add gbm. As gbm provides most satellites products, the default precise orbit and clock product is from gbm.
- (6) Similarly, for **ION Type**, when you choose **GIM** model, please add IGS ACs name after the file directory. For example, your GIM file is E:\products\igsg0010.18i, please make sure that the file directory is E:\products\igsg. In fact, when you change **Iono Type** from others to GIM, or then select a directory using **Select** pushbutton, the directory will automatically add codg. Considering update latency and precision, the default GIM product is from cod.

If you choose **GIM** model, you can **download** the GIM file.

If you choose **Klobuchar** model, the software will find brdm file in orbit directory if the Orbit type is broadcast ephemeris. If it is SP3, then the software will find brdm file in Ionosphere file directory.

If you choose **BeiDou 14** or **BeiDou Grid** model, you should have a standard BeiDou 14 parameter or grid file. If you don't have, please ignore it and don't use this model.

- (7) Please update **EOP file** and **Antenna File** when you are processing PPP/DPPP/Long Baseline RTK. If you use GLONASS data, please update **GLONASS Frequency & Leap second file**. Although most of time, these files doesn't update frequently or don't have so much influence on the result.
- (8) If you are processing PPP/DPPP/Long Baseline RTK, please check that if you have **Ocean Load Coefficient** of the station in Tide.txt. The Tide.txt is under the folder of Input and not shown in GUI, you have to update it by hand. Although most of time, ocean load tide doesn't have so much influence on the result.

- (9) **P1C1 DCB** file only provide the P1C1 DCB of GPS. As its value is very stable, you can **Update** it even once a year.
- (10) **GNSS BSX** file contains not only GPS P1C1 DCB, but also Multi-GNSS and Multi-frequency DCB. If you are processing single frequency or other combinations except L1L2 combination and not use broadcast file(As DCB/TDG contains in broadcast file), you can **Update** GNSS BSX file
- (11) When you set **Wet delay** as 0, it means the software will not estimate troposphere parameter. If it is greater than 0, troposphere parameter will be estimated. If the estimation mode is LS(Least Square), the troposphere will be estimated every wet delay time. If it is KF(Kalman Filter), it will be estimated as a random walk model, with a 1cm/sqrt(hour) walk step.
- (12) When the processing modes are **PCOR/PCOR+Orb/Zone PPP**, the BDS WADS PPP panel will show and you should have corresponding files. If you don't know these, please ignore them and don't choose these processing modes.
- (13) **DD** method in cycle slip is only valid for static station.
- (14) Please correctly set the Code/Phase/Doppler noise according to real situation.
- (15) Doppler observation is only valid in RTK currently.
- (16) When the processing mode is **RTK**, the RTK panel will show and you can choose proper **RTK Mode** and **AR Mode**. As for **Partial AR**, although the software provides three options of Yes 1, Yes 2 and No, it is always recommended that you choose Yes 2, although it may takes a little more time to process RTK ,but it is worthy in aspect of fix rate and precision.
- (17) If you use **Long Baseline RTK** mode, please remember to check **Est. Iono** (Estimate ionosphere). If you don't estimate ionosphere parameter, it is very hard to fix the ambiguity for long baseline.
- (18) If you want to forbidden the use of some satellites, you can click **Sat. Health** (Satellite Health) and uncheck the satellites you want.
- (19) The pushbutton of **SINEX** and **Header** means reading approximate station coordinate from a SINEX file or header of observation file.

When click pushbutton **Write**, it writes preparation file of Control.txt and Coor\_Table.txt for positioning. This would be useful if you want to debug the source code of Net\_Diff. When click pushbutton **Wt.& Run**, it writes preparation file of Control.txt and Coor\_Table.txt and start positioning.

You can check the hint information on each uicontrol to know their functions. However, as there are so many combinations of positioning settings, it is recommended to have your own try using your data.

### 3.3 Analysis

Click **Process→Analysis** or **Ctrl+A** to change to analysis page. If you are from positioning page, the coordinate file and log file will automatically change to the results you just processed.

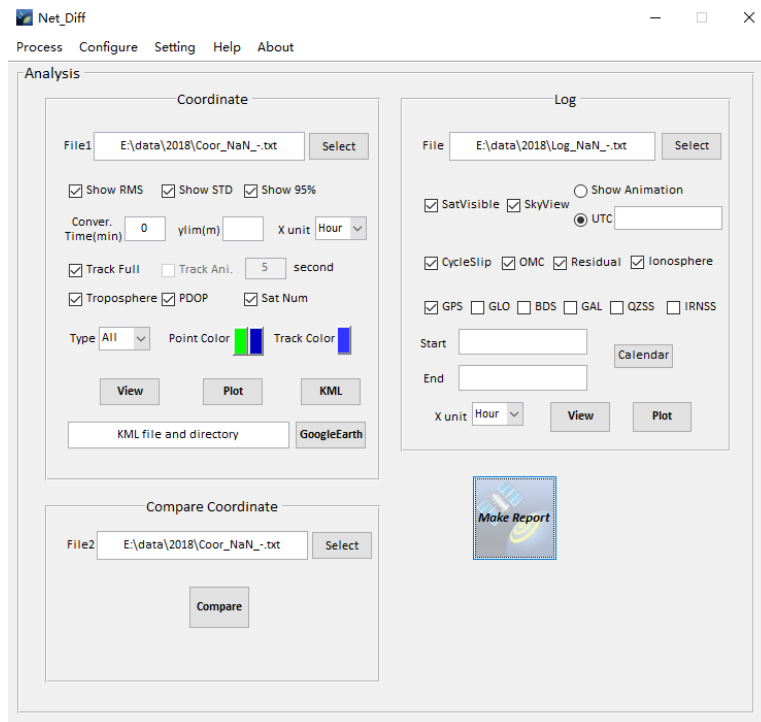


Fig. 5 Analysis Page

In this page, you can get analysis the positioning results and make positioning report through pushbutton of **Plot** and **Make Report**.

You can also make kml file in pushbutton **KML** and check the real positioning location on Google earth using pushbutton **GoogleEarth**(Make sure that you have installed Google Earth).

You can compare two positioning results in **Compare Coordinate** panel.

Please check the hint information on each uicontrol to know their functions.

### 3.4 Tool

Click **Process** → **Tool** or **Ctrl+T** to change to tool page.



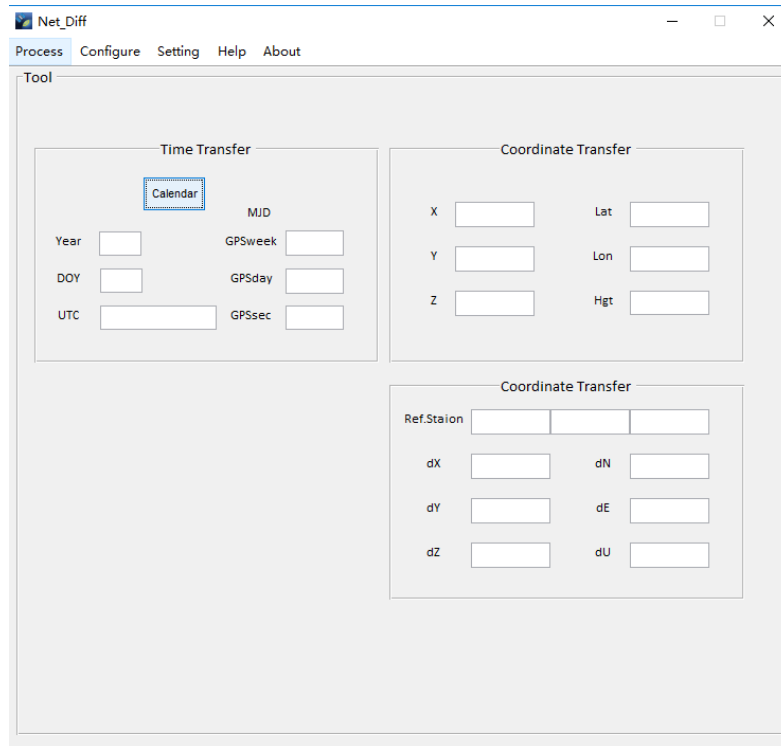


Fig. 6 Tool Page

In this page, you can get transfer between different time format and transfer coordinate system.

Please check the hint information on each uicontrol to know their functions.

### 3.5 Others

In the Configure menu, you can select **Save Configuration** or **Ctrl+S** to save your settings in positioning panel as a .cfg file. And you can select **Load Configuration** or **Ctrl+L** to load the existed .cfg file. This would be helpful if you want to do the same or similar positioning next time.

In the Setting menu, you can select voice hint in Chinese (**Voice(中文)**) or English (**Voice(English)**). If you don't want to use this function, please uncheck it.

In the Help menu, you can also open this help document using **How to use** or **Ctrl+H**. You can also find some resource website on **DataSource**. Besides, you can find **Website** of Net\_Diff on GitHub, the latest version of Net\_Diff will be uploaded on it, please remember to update it.

There are some examples in the folder of test on GitHub, including data, results and .cfg file. You can load the .cfg file and test them in your Net\_Diff.

## 4 How to Debug

If you have bugs when processing Net\_Diff, you can turn to debug it.

The GUI is in fact to generate two files, Control.txt and Coord\_Table.txt. And then the core execute file **Net\_Diff.dll** in Input folder will read these two files and start processing.

To start debug Net\_Diff:

- (1) Download the src of Net\_Diff from GitHub, which is under the src branch.
- (2) Use Visual Studio to make a new solution of Net\_Diff, and then load all src into the solution. Please make sure that you have installed Visual Fortran Compiler.
- (3) Copy the Control.txt and Coord\_Table.txt to your solution directory, or set your working directory the same as Net\_Diff.
- (4) Start to debug it!

## 5 Others

Please keep an eye on processing status window when you are using Net\_Diff, which will tell you your processing status. Or open voice hint so that you can turn to do other things while waiting.

If the processing status window doesn't refresh, try to press enter in processing status window to refresh.

If the positioning processing doesn't work, check if Net\_Diff.dll from last operation is still working in your task management window. If yes, please kill it and then retry Net\_Diff. If it still doesn't work, close Net\_Diff and restart it. So it is recommended to save the configuration every time.

If you have any questions or suggestions, please contact me: [zhyize@163.com](mailto:zhyize@163.com).

Thank you for using Net\_Diff.