**Documentation for StdSwc version 1.2.**

**General mode of operation:**

  StdSwc reads swc files, fixes some irregularities automatically and flags other anomalous lines as potential irregularities.  
Theses automatically fixed and flagged lines are documented in a standardization log file. Automatically changed lines are designated as type A while flagged lines are designated as type B1 unless they are corrected by hand in which case they are changed to type B2. Any additional irregularities, which are not detected by the program, are designated as type C.

**Irregularities:**

1. **Type Irregularities**

There are four standard segment types: **1** soma, **2** axon, **3** dendrite (basal when apical present), and **4** apical dendrite.  
Codes 5-10 signify custom types, and must be defined in header of the swc file when used.  
Soma (type 1) must start the cell and can only connect to itself.   
Apical and basal can only connect to their own type or to soma (possible exceptions for custom types).   
Type irregularities include:

* 1. **Non-existent type.**      Undefined custom type or type of -1.  
          **Fix:** flagged as type B1 and corrected by hand.
  2. **Incorrect type change**      1 or 4 attached to 3, etc.  
       Fix**:** Flagged as type B1 and fixed by hand unless following point is of the original type   
          (type change from 3 to 4 back to 3 in consecutive points for example)  
          in which case the irregularity is fixed automatically as a type A.
  3. **Incorrect type**      basal as apical, etc.  
          **Fix:** Type C irregularity, must be checked visually.

1. **Connection irregularities**

Trifurcations are not allowed. Only strict binary trees are permitted. Dendrites must start in the soma and work distally (no looping).

* 1. **Trifurcation**      **Fix:** Flagged as B1, one daughter branch is re-linked to the next nearest point  
          to the parent to create adjacent bifurcations.  
          Re-linking is done by hand to minimize angle disruption and avoid crossover of   
          daughter branches if possible.
  2. **Incorrect starting link**      Line 1 must link to -1.  
          **Fix:** Type A irregularity, line 1 link is automatically changed to -1.
  3. **Link to non-existent line number**      Link to a line number that occurs after the current point, or looping.  
          **Fix:** Flagged as type B1 irregularity and fixed by hand. May involve reordering points.
  4. **Long connection**      Equal or greater than 6 standard deviations above the average for that type of cell.  
          **Fix:** Flagged as a type B1 irregularity, fixed if incorrect and a plausible fix is possible.
  5. **Short connection.**     Two points in a branch, which are separated by less than .1 µm lengths.   
          **Fix:** Type A irregularity; Second point is automatically removed.
  6. **Two non-adjacent points occupying same space.**      **Fix:** Flagged as a type B1 irregularity. Generally second point is removed.  
          But other corrections may be necessary.
  7. **Included side branch**      Small side branch not long enough to escape the current diameter.  
          **Fix:** Type A irregularity; Point is automatically removed.

1. **File format irregularities**

Cell must be able to work with all common programs, especially Cvapp and L-Measure.

* 1. **Incorrect field delineator**      Only spaces are allowed, tabs are not.  
          Not typed, but automatically corrected as edited swc file is rewritten by program.
  2. **Incorrect (end of line) EOl, or (end of file) EOF delineators**      Only dos eols are permitted.  
          **Fix:** Change to correct type.
  3. **Outline or branching soma**      **Fix:** Type C irregularity determined through visual investigation.  
          Outline somas are reduced to line somas. Branches are removed form somas where possible.
  4. **Incorrect starting location**      File must start in soma.  
          **Fix:** Flagged as a type B1 irregularity. Cell is reordered to start in the soma.

1. **Radius irregularities**
   1. **Radius of zero**      **Fix:** Type A irregularity, radius is changed to that of its parent.
   2. **Large radius**      Radius equal to or greater than 4 standard deviations above the mean for that type of cell.  
           **Fix:** Flagged as a type B1 irregularity. Adjusted by hand if required.
   3. **Small Radius**      Radius less than or equal to .05 µm.  
           **Fix:** Flagged as a type B1 irregularity. Adjusted by hand if required.
   4. **Extreme taper**      Positive taper greater than or equal to a factor of 2   
           (daughter is twice as large as parent).  
           **Fix:** Flagged as a type B1 irregularity. Adjusted by hand if required.
   5. **Large terminal radius**      Radius 5 standard deviations above mean for terminal segments of a   
           particular type for the current cell.  
           **Fix:** Flagged as a type B1 irregularity. Adjusted by hand if required.

Type A irregularities are only corrected by the program if the -f or -fd command line switches are used. Type B irregularities are those that are flagged by the program. They are initially flagged as B1 with "(no action taken)" annotation. If they are addressed they are changed to type B2 with the annotation changed to record the correction. Those which are left as type B1 can have their annotation changed to signify why they were not changed, for example it was decided they were not in fact irregularities, or that no acceptable fix could be found. Type C irregularities are not flagged by the program, but are rather detected through visual inspection of the neuron.

**Command line switches:**

Many of the parameters of the program can be changed at the command line. The command line switches are given below with a brief description:

* -f and -fr Fix irregularities. If these switches are not given in the command line no changed swc file will be given. All irregularities listed above, as type A will be flagged as B1. The new swc file name prefix must follow this switch on the command line. The -fr switch will automatically change zero radius points to the parent radius while the -f switch will not.
* -nr Overrides the default minimum radius value. Must be followed on the command line by a "double value".
* -op Overrides the default user name which is used in the headers of the standardization log and edited swc file.
* -mr Overrides the default maximum radius standard deviation. Must be followed on the command line by a "double value".
* -tf Overrides the default maximum positive taper ratio. Must be followed on the command line by a "double value".
* -nl Overrides the default minimum segment length value. Must be followed on the command line by a "double value".
* -ml Overrides the default maximum length standard deviation. Must be followed on the command line by a "double value".
* -in Signifies end of command line switches and start of input file listing, must be last command line switch used before input files are listed.

**Usage and examples:**

Some example command lines for a hypothetical swc file "cellA.swc":

* java StdSwc.class cellA\_irregularities.std -in cellA.swc This is the simplest possible usage. No irregularities are fixed. Type B1 irregularities will be documented in "cellA\_irregularities.std". All default values are used.
* java StdSwc.class cellA\_irregularities.std -fd EditA.swc -in cellA.swc In this version all type A irregularities including zero radius will be automatically fixed and documented in "cellA\_irregularities.std". The edited version of the swc file will be saved as "cellA.swcEditA.swc".
* java StdSwc.class cellAn2irregularities.std -fd EditA.swc -in cellA.swc cell2.swc In this example irregularities from both cells will be documented in "cellAn2irregularities.std". "cellA.swcEditA.swc" and "cell2.swcEditA.swc" will be created for the two input files respectively.
* java StdSwc.class cellAirregularities.std -op Bob -ml 2 -fd EditA.swc -in cellA.swc In the above example the operator name has been changed from the default "Duncan Donohue" to "Bob" and the maximum length standard deviation has been changed from the default 6 to 2.