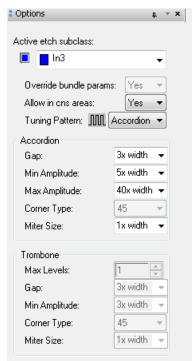
Auto Interactive Delay Tune (AiDT)

Summary - The *Auto Interactive Delay Tune* (AiDT) command improves user efficiency for generating tuning patterns on existing clines in the Allegro design. Users interactively select clines or cline segments for tuning. AiDT computes the required length for the cline to meet timing constraints and utilizes controlled push/shove techniques while adding tuning patterns based on parameters from the user.

Command – The *Auto Interactive Delay Tune* command is invoked from the Route – Unsupported Prototypes Menu

Options Form - The following options are available while running the AiDT command. User entered values are saved in the database between runs of Allegro.

- ➤ Override bundle params: This field determines if current Options parameters should override and bundle properties to control AiDT (if selected routing is part of a bundle). This is disabled in 16.5 version.
- ➤ **Allow in cns areas**: This allows the user to control if Tuning Patterns should be added inside constraint regions.
 - Default setting = Yes
- ➤ Tuning Pattern: Allows user to specify style of Tuning Pattern used. Accordion and Trombone patterns are supported. Based on the pattern selected, the corresponding parameters for that pattern will be available or disabled for setting values.
 - Default setting = Accordion



ACCORDION PARAMETERS

- ➤ **Gap**: A fill-in field for entering the desired gap between the sides of the Accordion pattern. This field also supports "[N] x width" or "[N] x space" values.
 - \circ Default setting = 3x width
- ➤ Min Amplitude: A fill-in field for entering the smallest desired height of Accordion patterns generated. This field also supports "[N] x width" or "[N] x space" values. AiDT will not generate accordion patterns if there is not enough space to meet the desired Min Amplitude.
 - \circ Default setting = 3x width
- ➤ Max Amplitude: A fill-in field for entering the maximum desired height of Accordion patterns generated. This field also supports "[N] x width" or "[N] x space" values. AiDT increases the size of Accordion patterns until the constraints are met, there is no more available space, or Max Amplitude has been reached.
 - \circ Default setting = 40x width
- ➤ Corner Type: This field is disabled. AiDT currently only generates 45 degree corners on Accordion patterns.
- ➤ Miter Size: A fill-in field for entering the desired corner size used for the Accordion patterns generated. This field also supports "[N] x width" or "[N] x space" values.
 - o Default setting = 1x width

TROMBONE PARAMETERS

- ➤ Max Levels: An integer value that specifies the max number of loops to create for each Trombone pattern.
 - o Default setting = 1
- ➤ **Gap**: A fill-in field for entering the desired gap between the sides of the Trombone pattern. This field also supports "[N] x width" or "[N] x space" values. AiDT will not create a pattern if the Gap cannot be met.
 - \circ Default setting = 3x width
- ➤ Min Amplitude: A fill-in field for entering the smallest desired length of Trombone patterns generated. This field also supports "[N] x width" or "[N] x space" values. AiDT will not generate Trombone patterns if there is not enough space to meet the desired Min Amplitude. Trombone patterns will not extend past the end of the existing segment they are being added on to.
 - o Default setting = 3x width
- ➤ Corner Type: This field is disabled. AiDT currently only generates 45 degree corners on Trombone patterns.

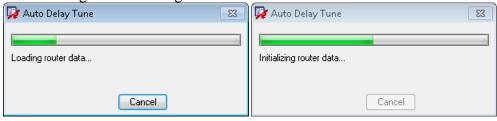
Functional Specification

- ➤ Miter Size: A fill-in field for entering the desired corner size used for the Trombone patterns generated. This field also supports "[N] x width" or "[N] x space" values.
 - \circ Default setting = 1x width

Find Filter – AiDT is meant to run on existing Clines or Cline Segments. Groups may also be used to select clines (e.g. Ratbundle of clines).

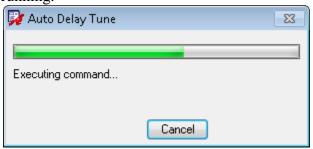
Procedure

- 1. Invoke the Auto Interactive Delay Tune command.
- 2. Set Tuning Pattern style in Options form.
- 3. Adjust parameter values for that style
- 4. Select clines or cline segments for tuning (select by pick, by window, by polygon, temp group) command will start as soon as selection is completed. Command progression below
 - a. AiDT may go through a load/analysis step before generating tuning patterns. The length of time for this step depends on the amount of data being analyzed. The following situations may trigger this step:
 - i. First time AiDT run in current Allegro session
 - ii. First time AiDT run on current open design
 - iii. Various edit changes made to the design since last AiDT run
 - iv. Using Undo in Allegro



Functional Specification

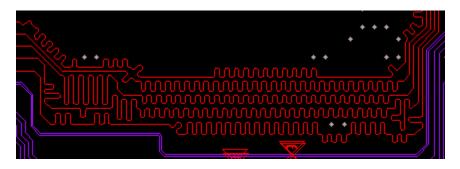
b. An execution dialog is shown while the tuning patterns are being generated. The activity bar will go back and forth from left to right to show the algorithm is still running.



c. When the AiDT run is complete, a results summary will be printed to the Allegro command window.

```
No element found.
콘 Clines Selected: 11; Timing constraints: 24; Timing violations: 1;
```

- d. Once the run is completed, the user should review the tuning results and determine next actions:
 - i. If AiDT results are acceptable, select next clines to process or RMB Done
 - ii. If AiDT results are not desirable, RMB Oops to rollback last AiDT run



Key Concepts

- 1. **Unselected Clines** AiDT only modifies clines that are selected during the command. All unselected clines do not get tuning added and are not pushed/shoved during the command. This is very effective to protect clines that may already be tuned, or to allow the user control over how much existing routing is modified during each AiDT run.
- 2. **Constraints** All electrical constraints that affect the cline being run are considered when determining the correct length for the cline. This includes net level or pin-pair constraints such as: Propagation Delay, Relative Propagation Delay, and Total Etch Length.
- 3. **Creating Space** AiDT will push all selected clines around as it makes space to add tuning structures. There may not be enough space available as AiDT runs into non-selected clines and some clines may not meet the timing constraint requirement. The user would then want to manually create more space and run some or all of the clines again.
- 4. **Logfile** The File->Viewlog command displays a logfile for the user that contains detailed information on each cline that was run during the command and any errors that may have occurred during processing.
- 5. **Existing Tuning** AiDT does not keep existing tuning patterns when it runs on a cline. It removes standard tuning patterns, cleans the general routing of the cline, then uses internal algorithms to create tuning patterns based on the AiDT parameters.
- 6. **Runsets** AiDT is most effective when run on 1-20 clines at a time. The exact amount of clines selected depends on the routing situation and timing constraints. Running AiDT on more than 20 clines at once may take excessive runtime or may cause significant changes to the initial routing.

Limitations

- 1. **Diff Pair Phase**: AiDT will not change the phase imbalance for a diff pair. It is recommended to get diff pairs into phase before running AiDT.
- 2. **Odd-angle routing**: AiDT will not add tuning patterns onto odd-angle cline segments. AiDT will also not push/shove any odd-angle cline segments during processing.
- 3. **Arcs**: AiDT will not add tuning patterns onto arc cline segments. AiDT will also not push/shove any arc cline segments during processing.
- 4. **Wide routing**: AiDT will not add tuning patterns onto cline segments that are routed wider than Min Line Width. AiDT will also not push/shove any cline segments during processing that are routed wider than Min Line Width.
- 5. **Shortening**: AiDT will not attempt to shorten signals to meet timing constraints. For Relative Propagation Delay constraints, all signals in the matchgroup will be increased to be within range of the longest signal.
- 6. **Dangling Clines**: AiDT will not add tuning patterns to dangling clines. The cline selected must be part of a connected rat (pin-pair) on the net.

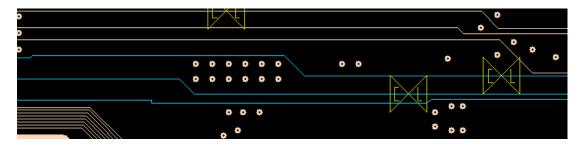
Use Models

Below are techniques and tips to effectively use AiDT in various design scenarios.

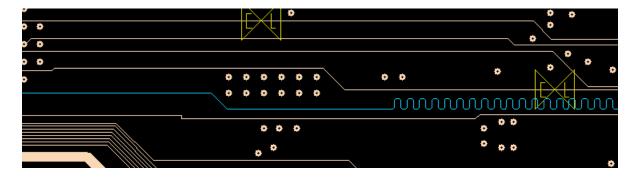
• **Single Cline Runs** – This technique is most effective when there is ample room for each cline to achieve timing, without the need to push/shove adjacent routing around. This technique is helpful if the user prefers to manually move routing around to create space for tuning. This technique also has the smallest impact on existing routing, since no push/shove is allowed.

Example:

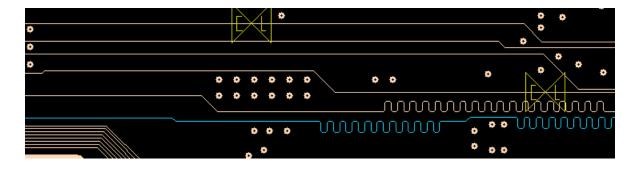
Starting clines



Running center cline first



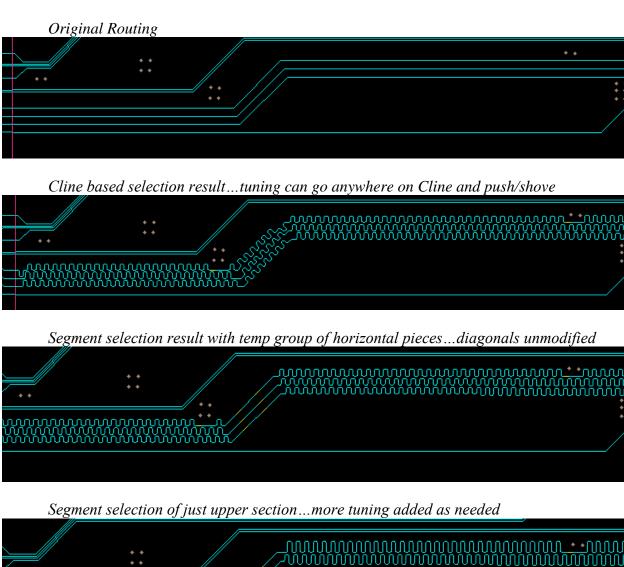
Running lower cline



• Cline segment tuning (rather than clines)

Selecting individual or groups of cline segments is a very effective means to control where elongation occurs with AiDT. Only selected segments can have elongation added and can push/shove during the operations. All unselected segments are considered 'fixed' during that operation and should undergo no changes. AiDT may become limited at the junction between selected and unselected segments where pushing cannot occur.

It is important to understand, AiDT attempts to add all needing tuning to satisfy the constraint when it runs. If a user selects a single segment, AiDT will attempt to add all required tuning to that segment. Selecting multiple segments at the same time will cause AiDT to distribute the elongation.



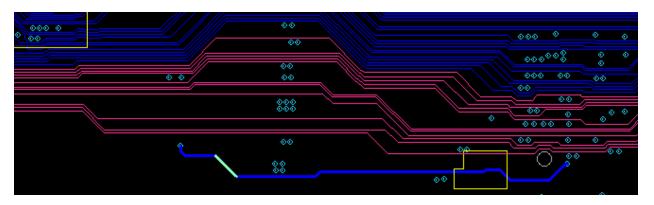
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Matchgroups

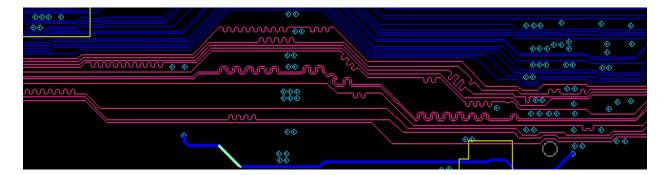
- Running the entire matchgroup This involves selecting all clines from a Matchgroup to run at the same time. This technique makes sense if all routing is nearby, on the same layer, and the cline count is less than 20 signals.
- Critical Signals It is important to understand the critical signals involved in a matchgroup when running AiDT, just as it is important to know these signals when manually tuning signals. The Longest signal in the matchgroup will dictate the overall length requirement for the other signals. This value is computed by AiDT. The Target (if there is one) will control the timing DRCs. If the Target signal does not get to its desired length during the AiDT run, this may cause a misleading amount of DRCs reported.
 - If AiDT cannot get the Target signal to the correct length, the user may want to tune that signal manually, and then run AiDT on the other signals in the group.
 - If the longest signal in the matchgroup is getting pushed too long during the AiDT run, the user may want to try a run by leaving that signal unselected during the run (select all other signals in the group). This will cause a physical cline barrier in the design, but may also prevent the overall length of the group from growing as the longest signal is pushed around.

Example:

Initial routing



Running entire matchgroup



- **Logfile Usage** Effective use of the AiDT logfile information will be important to efficiently determine how to proceed after the run has completed.
 - The command summary will give an indication of how many timing problems still exist, but the logfile PASS/FAIL messages will tell you which signals could not meet the computed values by AiDT. Signals that don't meet the computed values will be the most likely contributor to DRCs. The user may want to manually edit these signals, change routing to create space, or run groups of signals again through AiDT.

Example:

Command Window Summary:

```
Clines Selected: 11; Timing constraints: 24; Timing violations: 1; Command >
```

Logfile PASS/FAIL section identifies likely cause of the DRC

```
INFO (SPGRE-16): Cline at Via(5751.65, -123.80) - Via(2694.07, 412.86)
  on IN3 on Net M_A_DQS#0
INFO (SPGRE-16): FAIL: Rat CON0701.11 - U1001.AJ43: Budget[4274.02
  MIL, 4274.92 MIL]: Actual 4277.68 MIL
```

The DQS#0 signal did not meet the AiDT computed value (too long). This is the diff pair mate of the Target signal of the matchgroup. There is too large of a phase imbalance on the diff pair that must be corrected manually to meet timing.