CHAPTER 4

ANFIS BASED TOTAL DEMAND DISTORTION FACTOR

In distribution systems, the current harmonic distortion should be limited to an acceptable limit to avoid heating, losses and malfunctioning of power system components. The TDD was introduced in IEEE Std. 519-1992 (IEEE 1993) to measure the current distortion level instead of the THD that was introduced in the earlier version of the IEEE Std. 519-1981 (IEEE 1981).

4.1 CURRENT DISTORTION LIMITS

TDD, which is recommended in (IEEE 1993), is an index that quantifies the harmonics distortion level in the current waveform. TDD is the ratio of the harmonic current distortion to the maximum demand load current. According to (IEEE 1993), the TDD is defined as the total root-mean square harmonic current distortion in percent of the maximum demand load current (fundamental frequency component) at the point of common coupling. As seen in Table 4.1, the permissible distortion limits for the TDD depend on the ratio between the maximum short circuit current to the maximum demand load current which is \( I_{sc}/I_L \). Therefore TDD values alone are not enough to reveal whether the current distortion is within the allowable limits or not.

Although the value of the TDD index can quantify the current harmonic distortion level, it cannot reveal whether this distortion level is within or outside permissible limits. Therefore there is a need for an index
that can evaluate the current harmonic distortion and reveal whether this distortion is within or outside the allowable limits.

**Table 4.1 Current Distortion Limits for General Distribution System**

(120V through 69KV) - Maximum Harmonic Current Distortion in Percent of $I_L$

<table>
<thead>
<tr>
<th>$I_{SC}/I_L$</th>
<th>$&lt; 11$</th>
<th>$11 \leq h &lt; 17$</th>
<th>$17 \leq h &lt; 23$</th>
<th>$23 \leq h &lt; 35$</th>
<th>$35 \geq h$</th>
<th>TDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>4.0</td>
<td>2.0</td>
<td>1.5</td>
<td>0.6</td>
<td>0.3</td>
<td>5.0</td>
</tr>
<tr>
<td>20&lt;50</td>
<td>7.0</td>
<td>3.5</td>
<td>2.5</td>
<td>1.0</td>
<td>0.5</td>
<td>8.0</td>
</tr>
<tr>
<td>50&lt;100</td>
<td>10.0</td>
<td>4.5</td>
<td>4.0</td>
<td>1.5</td>
<td>0.7</td>
<td>12.0</td>
</tr>
<tr>
<td>100&lt;1000</td>
<td>12.0</td>
<td>5.5</td>
<td>5.0</td>
<td>2.0</td>
<td>1.0</td>
<td>15.0</td>
</tr>
<tr>
<td>&gt;1000</td>
<td>15.0</td>
<td>7.0</td>
<td>6.0</td>
<td>2.5</td>
<td>1.4</td>
<td>20.0</td>
</tr>
</tbody>
</table>

**Figure 4.1 Single-Phase Nonlinear Load Supplied from Sinusoidal Source**

For example, Figure 4.1 shows a nonlinear load supplied from a sinusoidal voltage source with root mean square value of 120 V and
fundamental frequency of 50 Hz. The nonlinear load consists of a pure resistance $R_{\text{Load}} = 100 \, \Omega$ with a Triac which is modeled by two thyristors connected in anti-parallel and with firing angle set to 30°. Two cases of line resistance are considered, the first is $R_{\text{Line}} = 2 \, \Omega$ which corresponds to short circuit current to maximum demand load current ratio of 51 and the second case is $R_{\text{Line}} = 1 \, \Omega$ which corresponds to short circuit current to maximum demand load current ratio of 101.

Both cases will have the same value of TDD of 14.1 but depending on the ratio of the short circuit current to maximum demand load current ($I_{\text{sc}}/I_L$) also called short circuit level (refer Table 4.1), it can be inferred that the current distortion in the first case will be outside the allowable limit but the current distortion in the second case will be within the limits. This example shows that although the value of the total demand distortion index can quantify the current harmonic distortion level, it cannot reveal whether this distortion level is within or outside permissible limits. Therefore there is a need for an index that can evaluate the current harmonic distortion and reveal whether this distortion is within or outside the allowable limits. Measuring the TDD index is accompanied by some uncertainties which stem from the following:

- Current transducers inaccuracies due to the difference between the designed turns-ratio and the actual voltage ratio.
- Measurement errors.
- Changes in power system operating conditions.
4.2 FUZZY LOGIC BASED TOTAL DEMAND DISTORTION FACTOR

This section deals with the fuzzy logic based approach used to calculate the FTDDF (Morsi 2008) which is an index that can indicate the cleanness of the current waveform from the harmonic distortion and can decide whether the existing distortion is within the permissible limits or not. Figure 4.2 shows a schematic diagram of the FTDDF module. This module can be built using the Fuzzy Logic Toolbox available in Matlab (2008). The design procedure is as follows.

**Figure 4.2 Schematic Diagram of the FTDDF Module**

4.2.1 Input and Output Fuzzification

The input to the FTDDF module is the ratio of the short circuit current to the maximum demand load current (short circuit level) $I_{sc}/I_{L}$ and the TDD. The values of $I_{sc}/I_{L}$ range as shown in Table 4.1 while the values of the TDD range from 0 to 1, a value of 0 indicates no distortion while a value near 1 indicates high distortion. Triangular form of the membership was used here to represent the short circuit level which represents the first input to the
FTDDF module. Triangular membership function is suitable to represent the ranges of the short circuit level since it is required to identify a certain range of values. Five linguistic variables are used to represent the short circuit level: low (L), somewhat low (SL), medium (M), somewhat high (SH), and high (H). Each linguistic variable that is represented by a rectangular membership function was designed to cover one of the ranges of the short circuit levels listed in Table 4.1. For example, the linguistic variable low (L) is used to represent the short circuit level (<20), while linguistic variable somewhat low (SL) is used to represent the short circuit level (20 to 50) and so on.

On the other hand triangular membership functions are used to represent the TDD which is the second input to the FTDDF module since it is required to identify the limits of the TDD as listed in Table 4.1. Seven linguistic variables are used: very low (VL), low (L), somewhat low (SL), medium (M), somewhat high (SH), high (H), and very high (VH). The linguistic variables used here identify the values of the TDD according to Table 4.1. For example, the linguistic variable very low (VL) is used to identify a value of around zero TDD, while the linguistic variable low (L) is used to identify a value around 5% of the TDD index and so on.

The FTDDF output is represented using the triangular membership function due to its simplicity. Seven linguistic variables are used here: low (L), moderately low (ML), somewhat low (SL), medium (M), somewhat high (SH), moderately high (MH), and high (H). These seven linguistic variables are used to cover the whole range of the FTDDF that extends from 0 to 1. Figure 4.3(a) to (c) show the input and output membership functions.
Figure 4.3  Input and Output Membership Functions (a) SC Level (b) TDD (c) FTDDF
4.2.2 Fuzzy If-Then Rules

Thirty five rules are designed in the FTDDF module. The following are the rules that were designed through a spreadsheet rule editor that supports the If-Then rules. The development of these rules is based on different combinations of the input linguistic variables using the “and” operator through the IF part of the statement, while the output linguistic variables help to determine the correct value for the FTDDF through the THEN part of the any rule.

1) If (S.C.LEVEL is L) and (TDD is VL) then (FTDDF is H)
2) If (S.C.LEVEL is L) and (TDD is L) then (FTDDF is MH)
3) If (S.C.LEVEL is L) and (TDD is SL) then (FTDDF is SH)
4) If (S.C.LEVEL is L) and (TDD is M) then (FTDDF is M)
5) If (S.C.LEVEL is L) and (TDD is SH) then (FTDDF is SL)
6) If (S.C.LEVEL is L) and (TDD is H) then (FTDDF is ML)
7) If (S.C.LEVEL is L) and (TDD is VH) then (FTDDF is L)
8) If (S.C.LEVEL is SL) and (TDD is VL) then (FTDDF is H)
9) If (S.C.LEVEL is SL) and (TDD is L) then (FTDDF is H)
10) If (S.C.LEVEL is SL) and (TDD is SL) then (FTDDF is MH)
11) If (S.C.LEVEL is SL) and (TDD is M) then (FTDDF is SH)
12) If (S.C.LEVEL is SL) and (TDD is SH) then (FTDDF is M)
13) If (S.C.LEVEL is SL) and (TDD is H) then (FTDDF is SL)
14) If (S.C.LEVEL is SL) and (TDD is VH) then (FTDDF is ML)
15) If (S.C.LEVEL is M) and (TDD is VL) then (FTDDF is H)
16) If (S.C.LEVEL is M) and (TDD is L) then (FTDDF is H)
17) If (S.C.LEVEL is M) and (TDD is SL) then (FTDDF is H)
18) If (S.C.LEVEL is M) and (TDD is M) then (FTDDF is MH)
19) If (S.C.LEVEL is M) and (TDD is SH) then (FTDDF is SH)
20) If (S.C.LEVEL is M) and (TDD is H) then (FTDDF is M)
21) If (S.C.LEVEL is M) and (TDD is VH) then (FTDDF is SL)
22) If (S.C.LEVEL is SH) and (TDD is VL) then (FTDDF is H)
23) If (S.C.LEVEL is SH) and (TDD is L) then (FTDDF is H)
24) If (S.C.LEVEL is SH) and (TDD is SL) then (FTDDF is H)
25) If (S.C.LEVEL is SH) and (TDD is M) then (FTDDF is H)
26) If (S.C.LEVEL is SH) and (TDD is SH) then (FTDDF is MH)
27) If (S.C.LEVEL is SH) and (TDD is H) then (FTDDF is SH)
28) If (S.C.LEVEL is SH) and (TDD is VH) then (FTDDF is M)
29) If (S.C.LEVEL is H) and (TDD is VL) then (FTDDF is H)
30) If (S.C.LEVEL is H) and (TDD is L) then (FTDDF is H)
31) If (S.C.LEVEL is H) and (TDD is SL) then (FTDDF is H)
32) If (S.C.LEVEL is H) and (TDD is M) then (FTDDF is H)
33) If (S.C.LEVEL is H) and (TDD is SH) then (FTDDF is H)
34) If (S.C.LEVEL is H) and (TDD is VH) then (FTDDF is MH)
35) If (S.C.LEVEL is H) and (TDD is M) then (FTDDF is H)

For example, in rule 1, if the S.C.LEVEL is low (< 20) and TDD is very low (around zero), then the FTDDF should have very high value in order to express an ideal case or a case that is within the allowed limits. On the other hand in rule 7, if the S.C.LEVEL is low (< 20) and TDD is very high (high distortion case), then the FTDDF should be expressed as low in order to give accurate impression about that distortion.

4.2.3 Fuzzy Inference Mechanism

Mamdani’s Fuzzy Inference Mechanism is used with the implication part modeled by means of the minimum operator while the aggregation part is processed using the maximum operator.
Figure 4.4 Rule Viewer Diagram of FTDDF - Case 1 (Outside the Limits)

Figure 4.5 Rule Viewer Diagram of FTDDF - Case 2 (Inside the Limits)
4.2.4 Output Defuzzification

Many defuzzification techniques (Zimmermann 1996) exist. The center of area (COA) or center of gravity (COG) method was used here, which returns the center of area under the curve resulting from the aggregation process. For the given values of the total demand distortion and short circuit level the fuzzy inference system module calculates the FTDDF.

Table 4.2 shows the rule viewer inputs and output for the two cases mentioned in the introduction. In the first case the FTDDF gives 0.682 which is less than 0.85, therefore it is outside the limit. In the second case the FTDDF yields 0.773 which is less than 0.85 even though the inputs TDD and SC level are within the acceptable limits.

The Rule Viewer Diagrams generated for FTDDF, using the Fuzzy Logic Toolbox available in MATLAB, for the cases “outside the limits” and “inside the limits” are shown in Figures 4.4 and 4.5 respectively. The Surface Viewer Diagrams of FTDDF, generated using the Fuzzy Logic Toolbox available in MATLAB, are shown in Figure 4.6.

<table>
<thead>
<tr>
<th>Category</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SC Level</td>
<td>TDD</td>
</tr>
<tr>
<td>Case 1</td>
<td>51</td>
<td>14.1</td>
</tr>
<tr>
<td>(outside the limits)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case 2</td>
<td>101</td>
<td>14.1</td>
</tr>
<tr>
<td>(within the limits)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.3 ANFIS BASED TOTAL DEMAND DISTORTION FACTOR

In this thesis, an ANFIS based Total Demand Distortion Factor (TDDF) is proposed, to evaluate the current harmonic distortion. In order to test its validity, it has been applied to different distortion cases in sinusoidal and non-sinusoidal situations. When considering a single range of short circuit level, the values of TDD are enough to quantify harmonic distortion in a certain current waveform. When considering multiple ranges of short circuit levels the TDD is unable to determine whether the distortion is within the acceptable limits or not. The flowchart for computing the proposed ANFIS-
TDDF value is illustrated in Figure 4.7. The schematic diagram of the ANFIS-TDDF module is shown in Figure 4.8. About 500 samples were trained to obtain the desired results.

Figure 4.7  Flowchart of ANFIS based TDDF Assessment
4.4 APPLICATIONS AND RESULTS

The ANFIS-TDDF indicates the level of distortion in the current waveform or how close is the waveform to a pure sinusoidal wave shape and also allows deciding whether the distortion contained in the current is within the acceptable limit or not. The proposed ANFIS-TDDF is sensitive to the TDD and short circuit level changes in all distortion cases in sinusoidal and non-sinusoidal situations.

The ANFIS-TDDF can handle both properties, its value expresses the extent up to which the current waveform is free of distortion, which means that a high value of TDD will correspond to a low value of ANFIS-TDDF and vice versa. Also values of ANFIS-TDDF less than 0.85 indicate that the distortion is within the limits.

In the proposed ANFIS-TDDF, two input variables – short circuit level and total demand distortion, both having seven linguistic values of gbel membership functions were assigned, as shown in Figure 4.9.

The Rule Viewer Diagrams generated for ANFIS-TDDF, using the Fuzzy Logic Toolbox (Matlab 2008) available in MATLAB, for the cases
“outside the limits” and “inside the limits” are shown in Figures 4.10 and 4.11 respectively.

Figure 4.9  Membership Functions of Input Variables (a) Short Circuit Level (b) TDD
Figure 4.10 Rule Viewer Diagram for ANFIS-TDDF (Outside the Limits)

Figure 4.11 Rule Viewer diagram for ANFIS-TDDF (Inside the Limits)
Comparison of the FTDDF and ANFIS-TDDF outputs, shown in Table 4.2, for the two Cases, within and outside the limits, show that the ANFIS based approach provides a better result.

To test the validity, performance and accuracy of the ANFIS-TDDF, it was applied to different distortion cases under sinusoidal and non-sinusoidal situations.

4.4.1 Sinusoidal Voltage Source

Figure 4.12 shows the voltage source waveform of sinusoidal case. Figures 4.13 (a and b) and 4.14 (a and b) show the current wave form with its Fast Fourier Transform (FFT) for case 4 which corresponds to $\alpha = 20^\circ$ and case 6 which corresponds to $\alpha = 30^\circ$. These two cases are shown for demonstration purposes.

![Figure 4.12 Source Voltage Waveform (Sinusoidal Case)](image)

Figure 4.12 Source Voltage Waveform (Sinusoidal Case)
Figure 4.13  Current Waveform for Sinusoidal Source Voltage - Case 4
(a) Time Domain Waveform (b) FFT Spectrum

Figure 4.14  Current Waveform for Sinusoidal Source Voltage - Case 6
(a) Time Domain Waveform (b) FFT Spectrum
Table 4.3 Values of TDD, FTDDF and ANFIS-TDDF for $R_{\text{Load}} = 50 \, \Omega$ in Sinusoidal Case

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>$R_{\text{Line}} = 2 , \Omega$; SC Level = 26</th>
<th>$R_{\text{Line}} = 1 , \Omega$; SC Level = 51</th>
<th>$R_{\text{Line}} = 0.1 , \Omega$; SC Level = 501.1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TDD</td>
<td>FTDDF</td>
<td>ANFIS-TDDF</td>
</tr>
<tr>
<td>0°</td>
<td>0.239</td>
<td>0.927</td>
<td>0.704</td>
</tr>
<tr>
<td>10°</td>
<td>2.979</td>
<td>0.927</td>
<td>0.704</td>
</tr>
<tr>
<td>15°</td>
<td>5.459</td>
<td>0.886</td>
<td>0.781</td>
</tr>
<tr>
<td>20°</td>
<td>8.274</td>
<td>0.826</td>
<td>0.861</td>
</tr>
<tr>
<td>25°</td>
<td>8.640</td>
<td>0.796</td>
<td>0.877</td>
</tr>
<tr>
<td>30°</td>
<td>11.026</td>
<td>0.796</td>
<td>1.100</td>
</tr>
<tr>
<td>35°</td>
<td>13.427</td>
<td>0.560</td>
<td>0.919</td>
</tr>
<tr>
<td>40°</td>
<td>15.786</td>
<td>0.505</td>
<td>0.981</td>
</tr>
</tbody>
</table>

Experimental results for sinusoidal voltage source shown in Table 4.3 reveal the following observations:

1. For the line resistance $R_{\text{Line}} = 2 \, \Omega$, the values of ANFIS-TDDF for cases 1, 2, 3 indicate that the distortion is within the limits.

2. The values of ANFIS-TDDF for cases 4, 5, 6, 7 and 8 indicate that the distortion is outside the limits.

3. For the line resistance $R_{\text{Line}} = 1 \, \Omega$, the values of ANFIS-TDDF for cases 1, 2, 3, 4 and 5 and for the line resistance $R_{\text{Line}} = 0.1 \, \Omega$, the values of ANFIS-TDDF for cases 1, 2, 3, 4, 5 and 6, indicate that the distortion is within the limits.

4. The values of ANFIS-TDDF for cases 6, 7, 8 indicate that the distortion is outside the limits for line resistance of $R_{\text{Line}} = 1 \, \Omega$.
5. As the firing angle of the thyristor increases, the current distortion increases and therefore, ANFIS-TDDF values increase.

6. All the cases that are within the limits have ANTIS-TDDF values less than 0.85 for $R_{\text{Line}} = 1 \, \Omega$ and 0.1 $\Omega$.

4.4.2 Non-Sinusoidal Voltage Source

Considering the circuit shown in Figure 4.1 the source voltage is now non sinusoidal shown in Figure 4.15 contains the fundamental plus 13.78% third harmonic such that the rms value is $V_1 = 120 \, V$ with $(f_1= 50 \, Hz)$ plus $V_3=16.536 \, V$ (with $f_3=150Hz$) and the remaining data all kept as in the sinusoidal situation. Figures 4.16 and 4.17 show the current waveform with its Fast Fourier Transform (FFT) for case 4 which corresponds to $\alpha = 20^\circ$ and case 6 which corresponds to $\alpha = 30^\circ$ respectively.

![Source Voltage Waveform (Non-Sinusoidal Case)](image)
Figure 4.16 Current Waveform for Non-Sinusoidal Source Voltage - Case 4 (a) Time Domain Waveform (b) FFT Spectrum

Figure 4.17 Current Waveform for Non-Sinusoidal Source Voltage - Case 6 (a) Time Domain Waveform (b) FFT Spectrum
Table 4.4 Values of TDD, FTDDF and ANFIS-TDDF for $R_{\text{Load}} = 50$ Ω in Non-Sinusoidal Case

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>$R_{\text{Line}} = 2$ Ω; SC Level = 26</th>
<th>$R_{\text{Line}} = 1$ Ω; SC Level = 51</th>
<th>$R_{\text{Line}} = 0.1$ Ω; SC Level = 501.1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TDD</td>
<td>FTDDF</td>
<td>ANFIS-TDDF</td>
</tr>
<tr>
<td>0°</td>
<td>15.638</td>
<td>0.509</td>
<td>0.972</td>
</tr>
<tr>
<td>10°</td>
<td>15.858</td>
<td>0.503</td>
<td>0.986</td>
</tr>
<tr>
<td>15°</td>
<td>16.360</td>
<td>0.488</td>
<td>1.030</td>
</tr>
<tr>
<td>20°</td>
<td>17.210</td>
<td>0.462</td>
<td>1.100</td>
</tr>
<tr>
<td>25°</td>
<td>18.375</td>
<td>0.432</td>
<td>1.130</td>
</tr>
<tr>
<td>30°</td>
<td>19.810</td>
<td>0.364</td>
<td>0.988</td>
</tr>
<tr>
<td>35°</td>
<td>21.440</td>
<td>0.248</td>
<td>0.991</td>
</tr>
<tr>
<td>40°</td>
<td>23.230</td>
<td>0.209</td>
<td>0.991</td>
</tr>
</tbody>
</table>

Experimental results for non-sinusoidal voltage source shown in Table 4.4 reveal the following observations:

1. For the line resistances $R_{\text{Line}} = 2$ Ω, 1 Ω and 0.1 Ω, the values of ANFIS-TDDF indicate that the distortion in all cases is outside the limits, because the voltages are now non-sinusoidal.

2. The ANFIS-TDDF values increase with the increase in distortion in the current waveform, when the firing angle is increased.

3. The ANFIS-TDDF values indicate that the distortion in all cases are outside the limits, which indicate that the ANFIS-TDDF values is affected by voltage distortion.
4. The ANFIS-TDDF values for the non sinusoidal case (Table 4.4) are higher than that of the ANFIS-TDDF values for the sinusoidal case (Table 4.3) due to the increase in the short circuit level, which indicates the high sensitivity of the ANFIS-TDDF for any change in the short circuit level.

5. ANFIS-TDDF clearly expresses this situation through giving values less than 0.85 for the acceptable cases and greater than 0.85 for unacceptable cases.

6. The ANFIS-TDDF is very sensitive to any change in either the TDD or the short circuit level or any distortion in the voltage waveform that affect the waveform of the current.

### 4.4.3 Case Study from Real Time Situation

In order to validate the experimental results obtained for the proposed ANFIS-TDDF, case studies from real time situation was also considered. FTDDF and ANFIS-TDDF was computed for the readings measured at the input of the power supply in the Computer Block of Mepco Schlenk Engineering College having non linear load of Uninterruptible Power Supplies (UPS) with a total capacity of 134 KVA.

Table 4.5 show the FTDDF and ANFIS-TDDF values obtained for the voltage and current readings recorded in the Power Room of the Computer Block on 01-02-2011 from 10.50 am to 11.50 am and from 2.10 pm to 3.10 pm. Table 4.5 shows that the ANFIS-TDDF clearly expresses the situation by giving values less than 0.85 for the acceptable cases and greater than 0.85 for the unacceptable cases.
Table 4.5 Values of TDD, FTDDF and ANFIS-TDDF for Case Study from Real Time Situation

<table>
<thead>
<tr>
<th>S. No.</th>
<th>(V_{\text{RMS}})</th>
<th>(I_{\text{RMS}})</th>
<th>SC LEVEL</th>
<th>TDD</th>
<th>FTDDF</th>
<th>ANFIS-TDDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>227.6</td>
<td>88.7</td>
<td>237.808</td>
<td>13.788</td>
<td>0.850</td>
<td>0.211</td>
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<tr>
<td>2.</td>
<td>227.4</td>
<td>75.9</td>
<td>277.669</td>
<td>17.64</td>
<td>0.757</td>
<td>0.860</td>
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<tr>
<td>3.</td>
<td>228.6</td>
<td>60.0</td>
<td>353.105</td>
<td>23.25</td>
<td>0.516</td>
<td>1.230</td>
</tr>
<tr>
<td>4.</td>
<td>228.9</td>
<td>70.6</td>
<td>300.480</td>
<td>19.60</td>
<td>0.670</td>
<td>0.860</td>
</tr>
<tr>
<td>5.</td>
<td>236.6</td>
<td>72.5</td>
<td>302.450</td>
<td>12.809</td>
<td>0.855</td>
<td>0.453</td>
</tr>
<tr>
<td>6.</td>
<td>235.0</td>
<td>70.5</td>
<td>308.928</td>
<td>15.739</td>
<td>0.857</td>
<td>0.850</td>
</tr>
<tr>
<td>7.</td>
<td>234.7</td>
<td>66.0</td>
<td>329.570</td>
<td>18.355</td>
<td>0.731</td>
<td>0.976</td>
</tr>
<tr>
<td>8.</td>
<td>234.8</td>
<td>57.1</td>
<td>381.010</td>
<td>22.29</td>
<td>0.532</td>
<td>1.660</td>
</tr>
<tr>
<td>9.</td>
<td>234.2</td>
<td>77.5</td>
<td>303.570</td>
<td>17.68</td>
<td>0.755</td>
<td>0.920</td>
</tr>
</tbody>
</table>