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| U.S. Radiocommunications Sector  Fact Sheet | |
| **Working Party:** ITU-R WP 5B | **Document No:** USWP5B31-xx |
| **Ref:**  **Annex 6 to Document 5B/731-E** | **Date:** January 25, 2023 |
| **Document Title:** PRELIMINARY DRAFT REVISION OF RECOMMENDATION ITU-R M.1851-1  Mathematical models for radiodetermination radar and aeronautical mobile systems antenna patterns for use in interference analyses | |
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| **Purpose/Objective:** The purpose of this contribution is to show that the proposed cosine on a pedestal does not need to be included in M.1851 | |
| **Abstract:** We should leave M.1851 as it is without the inclusion of cosine on a pedestal pattern as this just adds unneeded complications. The parabolic patterns are expected to also show similar results and are not included in this contribution. | |
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**Recommendation.**

We should leave M.1851 as it is without the inclusion of cosine on a pedestal pattern as this just adds unneeded complications. The parabolic patterns are expected to also show similar results and are not included in this contribution.

**Analysis**

At the last meeting of WP-5B, cosine on a pedestal procedure was introduced. The radiation patterns for a raised cosine to the power n are formed by adding the uniform pattern multiplies by the pedestal edge illumination plus (1- pedestal edge illumination) multiplied by the cosine to the power n. The equations of the uniform and the cosine to the power n are found in ITU-R Recommendation M.1851.

The problem with cosine on a pedestal is that there could be several ways to obtain the peak sidelobe levels and this makes it difficult to choose the appropriate pattern for compatibility analysis. For example, if an ITU-R Recommendation has only the peak sidelobe of about 21 dB below the antenna peak gain and the actual pattern type is not provided, then what should be chosen for the pattern. The highlighted cell in table-1 shows that a possible choices could include Cos with pedestal edge factor of 0.2, or Cos2 with pedestal edge value of 0.5 or Cos3 with pedestal edge value of 0.4. These patterns may be similar but checking whether they are or not requires extra analysis.

To plot the radiation patterns with pedestal edge illumination the following beamwidth factor, K, should be used. If other pedestal edge illumination values are needed those can also be derived.

**Table-1 Values of K (Beamwidth Factor) and Sidelobe Level**

| **Pedestal**  **Value** | **K COS** | **SLL COS** | **K COS2** | **SLL COS2** | **K COS3** | **SLL COS3** | **K COS4** | **SLL COS4** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 68.1365 | -23 | 82.5443 | -31.46 | 95.0555 | -39.2954 | 106.1805 | -46.7411 |
| 0.1 | 64.56 | -22.7166 | 73.13 | -40.0616 | 78.57 | -34.0733 | 82.11 | -32.3622 |
| 0.2 | 61.72 | -21.65 | 67 | -31.596 | 69.63 | -25.09 | 70.87 | -28.176 |
| 0.3 | 59.46 | -20.2855 | 62.81 | -26.7936 | 64.09 | -23.3392 | 64.52 | -20.2195 |
| 0.4 | 57.6 | -18.9125 | 59.7 | -24.076 | 60.37 | -21.8747 | 60.44 | -19.7713 |
| 0.5 | 55.95 | -17.6515 | 57.34 | -21.2063 | 57.67 | -20.7696 | 57.63 | -19.3178 |
| 0.6 | 54.64 | -16.5321 | 55.47 | -18.644 | 55.62 | -19.9149 | 55.55 | -18.9205 |
| 0.7 | 53.47 | -15.5496 | 53.98 | -16.774 | 54.02 | -17.4181 | 53.95 | -17.7341 |
| 0.8 | 52.45 | -14.6882 | 52.71 | -15.3382 | 52.74 | -15.6399 | 52.67 | -15.7713 |
| 0.9 | 51.58 | -13.9308 | 51.69 | -14.1955 | 51.65 | -14.3056 | 51.67 | -14.3498 |
| 1 | 50.7741 | -13.2615 | 50.7741 | -13.2615 | 50.7741 | -13.2615 | 50.7741 | -13.2615 |

The effect of pedestal edge illumination on different patterns combinations is shown in table-2.

**Table-2 Effect of pedestal edge illumination on different patterns combinations.**

| **Pattern** | **Effect of pedestal edge illumination (C)** |
| --- | --- |
| Cos | * The peak sidelobe increases up to the uniform pattern level as the pedestal edge illumination is increased. * The sidelobe pattern slops down from the first peak sidelobe similar to the case where the pedestal edge illumination. * This pattern may be used. * The peak and average pattern equations are not provided. |
| Cos2 | * The peak sidelobe increases up to the uniform pattern level as the pedestal edge illumination is increased. * The first sidelobe is below the adjacent sidelobes. * It is preferred to use pedestal edge illumination greater than 0.5 to obtain a usable pattern for radar antennas. * The peak and average pattern equations are not provided. |
| Cos3 | * The peak sidelobe increases up to the uniform pattern level as the pedestal edge illumination is increased. * The first sidelobe is below the adjacent sidelobes. In some cases, the first sidelobe is merged with the main lobe. * It is preferred to use pedestal edge illumination greater than 0.5 to obtain a usable pattern for radar antennas. * The peak and average pattern equations are not provided. |
| Cos4 | * The peak sidelobe increases up to the uniform pattern level as the pedestal edge illumination is increased. * The first sidelobe is below the adjacent sidelobes. In some cases, the first sidelobe is merged with the main lobe. * It is preferred to use pedestal edge illumination greater than 0.5 to obtain a usable pattern for radar antennas. * The peak and average pattern equations are not provided. |

Plots of radiation patterns with different pedestal edge illuminations.

**Table-3 Table of Figures for different patterns with varying pedestal edge illuminations**

|  |  |  |
| --- | --- | --- |
| No Pedestal |  |  |
| Hamming C=0.08 |  |  |
| C=0.1 |  |  |
| C=0.2 |  |  |
| C=0.3 |  |  |
| C=0.4 |  |  |
| C=0.5 |  |  |
| C=0.6 |  |  |
| C=0.7 |  |  |
| C=0.8 |  |  |
| C=0.9 |  |  |
| C=1 |  |  |