

# Matlab Code to Design A Slotted Waveguide Array Antenna

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## Abstract

This article presents a MATLAB script used to design slotted waveguide array (SWA) antennas. A brief theory of the antenna is discussed to understand the scope and requirement of this code. A numerical comparison is also presented to design a SWA of 25 GHz to validate the proposed script.

## I. INTRODUCTION

Slotted waveguide array antenna is known for its high power radiation and is often employed in space applications. It possesses a significantly high antenna gain by exploiting the radiations through multiple slots placed at half wavelength distances. The effects of slots on waveguide is thoroughly discussed in [1] which inspired the design of SWA as discussed in [2]–[4]. The slot placement on the waveguide plays a critical role to optimize the antenna radiation at a given frequency. In this article a MATLAB script is presented which is inspired by the analytical discussion presented in [3], [4]. A brief theory of SWA is discussed in Sec. II which is followed by the Matlab script in Sec. III, numerical validation in Sec. IV and conclusion in Sec. V.

## II. THEORY

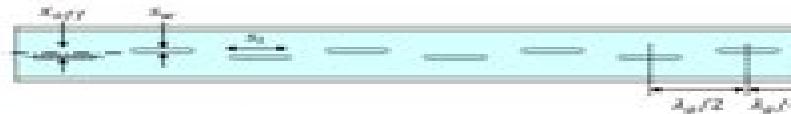


Fig. 1. Schematic of a SWA indicating the slot length  $s_z$ , slot width  $s_w$  and slot offset from the longitudinal axis  $x_{eff}$ .  $\lambda_g$  is the guided wavelength at the operating frequency considering the waveguide dimensions.

Schematic of a conventional SWA is shown in Fig. 1. It consists of a rectangular waveguide terminated at one end with multiple slots on one of its broad wall. The slots are placed longitudinally in a tandem orientation by maintaining a distance of the multiple of the guided wavelength ( $\lambda_g$ ). It increases the interaction of slots with the standing wave inside the terminated waveguide to increases the antenna radiation. The total radiated electric field ( $E_r(\theta)$ ) can be approximated using array theory by considering the radiation from individual slots

$$E_r(\theta) = f(\theta) \sum_{n=1}^N \alpha_n e^{jnk^2 \theta \cos \theta} \quad (1)$$

where,  $f(\theta)$  the is radiated electric field of a slot,  $\alpha_n$  is the magnitude of excitation coefficient of the  $n$ th slot,  $k$  is the free space wave number at the operating frequency and  $\theta$  is the angle of observation. Since the slot-field is a function its placement about the waveguide axis, the conductance of the  $n$ th slot can be calculated from the excitation coefficients as

$$g_n = \frac{\alpha_n^2}{\sum_{n=1}^{N/2} \alpha_n^2} \quad (2)$$

It can also be expressed in terms of the design parameters of the SWA as

$$g_n = 2.09 \frac{\lambda_0}{\lambda_g} \frac{a}{b} \cos^2 \left( \frac{\pi \lambda_0}{2 \lambda_g} \sin^2 \left( \frac{\pi x_{eff}}{a} \right) \right) \quad (3)$$

where,  $a$  and  $b$  are the inner dimensions of the corresponding waveguide. These equations are used to design the SWAs at the operating frequency as will be explained in the following section.

# Dielectric Waveguide Model Matlab Code

**John E. Carroll,James Whiteaway,Dick  
Plumb**

## **Dielectric Waveguide Model Matlab Code:**

*Millimeter-Wave Waveguides* Dmitri Lioubtchenko, Sergei Tretyakov, Sergey Dudorov, 2007-05-08 Millimeter Wave Waveguides is a monograph devoted to open waveguides for millimeter wave applications. In the first chapters general waveguide theory is presented with the emphasis on millimeter wave applications. Next the book systematically describes the results of both theoretical and experimental studies of rectangular dielectric rod waveguides with high dielectric permittivities. Simple and accurate methods for propagation constant calculations for isotropic as well as anisotropic dielectric waveguides are described. Both analytical and numerical approaches are covered. Different types of transitions have been simulated in order to find optimal configurations as well as optimal dimensions of dielectric waveguides for the frequency band of 75–110 GHz. Simple and effective design is presented. The experimental studies of dielectric waveguides show that Sapphire waveguide can be utilized for this frequency band as a very low loss waveguide. Design of antennas with low return loss based on dielectric waveguides is also described.

**Advances in Networks, Security and Communications: Reviews, Vol. 2** Sergey Yurish, 2019-12-03 Written by 31 contributors from academy and industry from 12 countries Austria, Bulgaria, China, Croatia, Germany, India, Iran, Singapore, South Korea, Taiwan, UK and USA, the book contains 14 chapters divided into three main parts: Networks (six chapters), Communications (seven chapters) and Security (one chapter). With this unique combination of information in each volume, the *Advances in Networks, Security and Communications: Reviews* Book Series will be of value for scientists and engineers in industry and universities. Like the first volume of this book Series, the second volume also has been organized by topics of high interest. In order to offer a fast and easy reading of the state of the art of each topic, every chapter in this book is independent and self-contained. This book ensures that our readers will stay at the cutting edge of the field and get the right and effective start point and road map for the further researches and developments.

*Theory and Design of Terabit Optical Fiber Transmission Systems* Stefano Bottacchi, 2014-10-02 This comprehensive modular treatment of the challenging issues involved in very high speed optical transmission systems contains all the theory and practical design criteria required to optimise transmission system design. Each chapter covers the theoretical modelling of a given system; chapters are well supported by real world worked examples and accompanied by MATLAB code and receiver design examples. Critical analysis and comparison of engineering solutions is presented to make clear the principles underlying system performance optimisation and a broad range of transmission systems is discussed, including the status and performance demands of the Terabit systems now entering the next generation market. Blending theoretical and practical considerations for high speed fibre optic systems design, this is an indispensable reference for all forward looking professionals and researchers in optical communications.

**Distributed Feedback Semiconductor Lasers** John E. Carroll, James Whiteaway, Dick Plumb, 1998 Concentrating on presenting a thorough analysis of DFB lasers from a level suitable for research students, this book emphasises and gives extensive coverage of computer

aided modeling techniques      **Journal of the Optical Society of America** ,2001      *Fundamentals of Electromagnetics with Engineering Applications* Stuart M. Wentworth,2005      *Balanis' Advanced Engineering Electromagnetics* Constantine A. Balanis,2024-01-31 Balanis Advanced Engineering Electromagnetics The latest edition of the foundational guide to advanced electromagnetics Balanis third edition of Advanced Engineering Electromagnetics a global best seller for over 30 years covers the advanced knowledge engineers involved in electromagnetics need to know particularly as the topic relates to the fast moving continuously evolving and rapidly expanding field of wireless communications The immense interest in wireless communications and the expected increase in wireless communications systems projects antennas microwaves and wireless communications points to an increase in the number of engineers needed to specialize in this field Highlights of the 3rd Edition include A new chapter on Artificial Impedance Surfaces AIS contains material on current and advanced EM technologies including the exciting and fascinating topic of metasurfaces for Control and broadband RCS reduction using checkerboard designs Optimization of antenna fundamental parameters such as input impedance directivity realized gain amplitude radiation pattern Leaky wave antennas using 1 D and 2 D polarization diverse holographic high impedance metasurfaces for antenna radiation control and optimization Associated MATLAB programs for the design of checkerboard metasurfaces for RCS reduction and metasurface printed antennas and holographic L WA for radiation control and optimization Throughout the book there are Additional examples numerous end of chapter problems and PPT notes Fifty three MATLAB computer programs for computations graphical visualizations and animations Nearly 4 500 multicolor PowerPoint slides are available for self study or lecture use      **Integrated Photonics Research** ,2001      **Science Abstracts** ,1995      **Physical Review** ,2000-11 Publishes papers that report results of research in statistical physics plasmas fluids and related interdisciplinary topics There are sections on 1 methods of statistical physics 2 classical fluids 3 liquid crystals 4 diffusion limited aggregation and dendritic growth 5 biological physics 6 plasma physics 7 physics of beams 8 classical physics including nonlinear media and 9 computational physics      **Proceedings of Bianisotropics '97** Werner S. Weighhofer,1997      **Biomonitoring and Endoscopy Technologies** Israel Gannot,2001      **Digital Signal Processing Applications** ,1999      *Proceedings* ,1999      **Electrical & Electronics Abstracts** ,1997      *Digest IEEE Antennas and Propagation Society. International Symposium*,1997      *Conference Proceedings* ,1994      **Applied Electromagnetics** Stuart M. Wentworth,2007-01-09 The revolution in wireless communications calls for a new focus in the electrical engineering curriculum Stuart M Wentworth fills that need with his new Applied Electromagnetics A Transmission Lines First Approach Incorporating the popular MATLAB program throughout it features practical applications for wireless systems transmission lines waveguides including optical fiber antennas and microwave systems Designed for use in a one or two semester sequence at the junior and senior level it offers students both detailed theoretical grounding and hands on experience in harmony with today s professional practice      *International Aerospace Abstracts* ,1999      **Plasma and**

**Fusion Science** J. Julio E. Herrera Velázquez, 2006-12-13 Mexico City Mexico 5 9 December 2005

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