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Review paper of Bandwidth Enhancement of Microstrip Antenna using Stacked

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Abstract: *This paper represents the enhancement of bandwidth for microsrip antenna along with its structure. The survey includes the way to enhance bandwidth using special structure of patch instead rectangular patch. The antennas are very essential device for communication as it is used as a transmitter device and receiving device. For the microwave frequency communication the Microstrip patch antenna is the best choice. But it suffers from the problem of narrow bandwidth hence it necessary to overcome this disadvantage.*

Keywords:*MicrostripPatchAntenna,BandwidthImprovementOfMSA,StructureOfMSA*

I. INTRODUCTION:

Two most serious limitations of the micros tripantennasareitslowgainandnarrow bandwidth.Thecompactantennaconfigurationfurtherdeterioratesthesetwoparameters.Thisisbecauseofthefactthatthereisafundam entalrelationshipbetweenthesize,bandwidthandefficiencyofanantenna.Asantennasaremadesmaller,eithertheoperatingbandwidth ortheantennaefficiency mustdecrease.Thegainisalsorelated tothesizeoftheantenna,thatissmallantennastypicallyprovide lowergainthanlargerantennas.

Therefore,thesize reduction,togetherwithgainandbandwidthenhancementisbecomingmajordesignconsiderationsformostpracticalapplicationsofmic rostripantennasforwirelesscommunication.Anumberoftechniqueshavebeenreportedbytheresearcherstoenhancethegainandbandw idthofmicrostripantennas.Someofthemusedtoenhancethegainare,loading ofhighpermittivitydielectricsuperstrate[1],inclusionofanamplifiertypeactivecircuitry [2]andstackedconfiguration[3].Useofsuperstrateloadingtechniquehelpsinincreasingtheradiationefficiency.Amplifiercircuitscana lsobeintegrated withtheradiatingpatch togiverisetoan activeintegratedantenna.In stackedconfigurationtwopatches,drivenandparasitic,areusedwithdesiredfeedingtechnique.

Thenarrowimpedancebandwidthofthebasicmicrostripelementisultimatelyaconsequenceofitselectricallythinground-plane-backeddielectricsubstrate,whichleadstoahighQresonancebehavior.Bandwidthimprovesasthesubstratethicknessisincreased,orthe dielectricconstantisreduced,butthesetrendsarelimitedbyaninductiveimpedance offsetthatincreaseswiththickness.Alogical approach,therefore,istouseathicksubstrateorreplacingthesubstratebyairorthickfoam[4]withsometypeofadditionalimpedancematc hingtocancelthisinductance.Thicksubstrateintroducessurfacewaveexcitation.Anothermethod reported[5]forthebandwidthenhancementisbyloadingthe suspended microstrip antennawithdielectric resonator.

Thestacked patcharrangement [12]isverypopular,with reportedbandwidthsrangingfrom 10%to 20%.Owingtothefactthatthestackedconfigurationenhancesboththegainandbandwidth,thisparticularchoiceispreferredinthepresen twork.

II. FEEDINGTECHNIQUES

Microstrippatch antennascanbefedbyavarietyofmethods.Thesemethodscanbeclassifiedintotwocategories-contactingandnon-contacting.Inthecontactingmethod,the RFpowerisfeddirectlyto theradiatingpatchusingaconnectingelementsuchasamicrostripline.Inthenon-contactingscheme,electromagneticfieldcouplingisdonetotransferpowerbetweenthemicrostriplineandtheradiatingpatch.Thefour mostpopularfeedtechniquesused arethemicrostripline,coaxialprobe(both contactingschemes),aperturecouplingandproximitycoupling(bothnon-contactingschemes).Thetechniquesareasfollows.

- Microstriplinefeed
- CoaxialFeed
- ApertureCoupledFeed
- ProximityCoupledFeed5CoplanarWaveguideFeed

BANDWIDTHOFMSA

The bandwidth ofthepatchis definedas thefrequencyrangeoverwhichitismatchedwiththatofthefeedlinewithinspecifiedlimits.Inotherwords,thefrequencyrangeoverwhichtheantennawillperformsatisfactorily.Thismeansthechannelshavelargerusablefrequencyrange andthusresultsinincreasedtransmission.Thebandwidthofanantennaisusuallydefinedbytheacceptablestandingwaveratio(SWR)valueovertheconcerned frequencyrange.

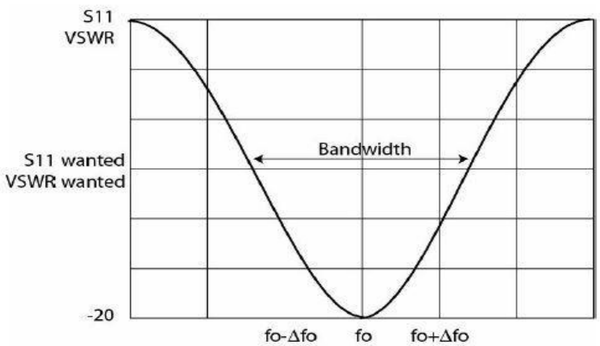

Figure: Bandwidth

HOW TO IMPROVE BANDWIDTH OF MSA

The demand for wireless communication is designing of proper wideband antenna. The microstrip is the best choice for wireless communication, but before using it in the field it is necessary to improve the bandwidth of it. There are lots of issues regarding the bandwidth enhancement of MSA. The possible ways to increase the bandwidth are as follows.

1 multilayer structure.

2 varying the patch size

3 stacked patches

4 parasitic patches.

The patch sizes are available such as U shape, E shape, L shape.

III. STACKED CONFIGURATION:

Stackedconfigurationsarepossiblewithaperturecoupledfeeding,proximityfeedingandco-axialfeeding.Probe-feedingtechniqueisre-emerginginvarietyofantennasystemduetoitsrobustnature.Itprovidesgoodisolation betweenfeednetworkandradiatingelementsandduetodirectcontactwiththeradiatorreducesdielectriclayermisalignmentdifficulties. Italsoyieldsgoodfronttobackratiowhichisveryimportantwheremultiplearraysarelocated back-to-back inclosedproximity.Thereforestackedconfigurationswith probe-fed havebeenconsidered.

Considerableamountofliteratureisavailablewhichprovidesguidelinestodesignaprobefed stacked patch. Ithasbeenreported,thatthecombinationoflowdielectricconstantandhighdielectricconstantcanyieldgoodimpedancebehavior.The broadestbandwidthcanbeachievedwhenthefirst-ordermode onthe lowerpatchis considerablygreaterinmagnitudethancorrespondingmode onthetop patchorinotherwordsthetoppatchis looselycoupled.Forthisthesubstrate oflowerpatchshould havehigherdielectric constant thantheuppersubstrate.

Thethickness ofeachlayeralsoplaysanimportantrole inachievingtheoverallbandwidth.Thethickerthelower layer,thegreaterthebandwidthwillbe.Ithasbeensuggested thatthelower patchshouldbedesigned suchthatitisstronglycapacitiveoverthedesiredrangeoffrequencyinsteadofdesigningitfortheminimumreturnloss.Buttheoverallimpedancewillbecomeinductivewhenparasiticpatchisplacedontotheconfiguration,iflowerlayeristoothick.Henceatradeoffmustbemadebetweenthe bandwidthandthe impedance control.

Thethicknessofuppersubstrate(h2)dependsuponthethicknessoflowersubstrate(h1).Thegreaterh1leaveslessfreedomfortheh2.Forl owerreturnlossh2mustbe increased.

2.4 Design step for patch antenna

Specify: ε_r, f_r(in Hz), and h

For the designing purpose of patch antenna first the Resonant frequency (f_r), material of substrate, its dielectric constant (permittivity, ε_r) and its height(h) is decided.

Determine W, L and ε_{rff}

Various formulas for effective dielectric constant (ε_{rff}), length (L) and width(W) of the patch are as give below.

W/h>1

$$\varepsilon reff = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2} \quad \dots (1)$$

$$\frac{\Delta L}{h} = \frac{(0.412)(\varepsilon reff + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon reff - 0.258)\left(\frac{W}{h} + 0.8\right)} \quad \dots (2)$$

$$Leff = L + 2\Delta L \quad \dots (3)$$

$$W = \frac{1}{2fr\sqrt{\mu o \epsilon o}}\left(\sqrt{2}/\sqrt{(\varepsilon r + 1)}\right)$$

$$= \frac{v0}{2fr}\left(\sqrt{2}/\sqrt{(\varepsilon r + 1)}\right) \quad \dots (4)$$

$$L = \frac{1}{2fr\sqrt{\varepsilon reff}\sqrt{(\varepsilon o \mu o)}} - 2\Delta L \dots (5)$$

$$fr = \frac{1}{2fr\sqrt{\varepsilon r}\sqrt{(\varepsilon o \mu o)}} = \frac{vo}{2L\sqrt{\varepsilon r}} \dots (6)$$

IV. CONCLUSION

The various aspects of microstrip antennas have been studied & presented in this paper. Such as structure of microstrip antenna its feeding techniques, designing step and different techniques. The main objective of this study is to make a special structure of patch to get better bandwidth than rectangular patch. The designing aspect related to software and fabrication processes are also presented in this paper.

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