Application Sheet

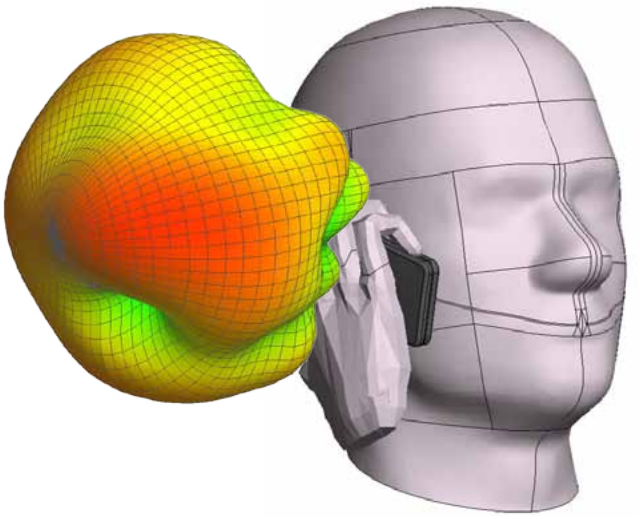
FEKO

Comprehensive Electromagnetic Solutions

Wireless Antenna Design and Compliance

Introduction

With the roll-out of fourth generation (4G) networks across the world, compatible smartphones and tablets are becoming the norm. The design and integration of wireless antennas are increasingly receiving attention in a competitive industry. Consumer trends favour the design of slimmer devices, creating the challenge to develop a device that covers the broad frequency spectrum of 4G. Adding to the challenge is the requirement to satisfy the CTIA Wireless Association over-the-air (OTA) and specific absorption rate (SAR) criteria while also maintaining an aesthetically pleasing device. Multiple-input multiple-output (MIMO) antennas are widely used to improve communications. It reduces multipath fading while offering other advantages due to spatial diversity of the antenna in the device (for example better performance against loading of the user's hand). FEKO's complete approach presents engineers with the tools to tackle the design of a wireless antenna during the design cycle from concept to final design.

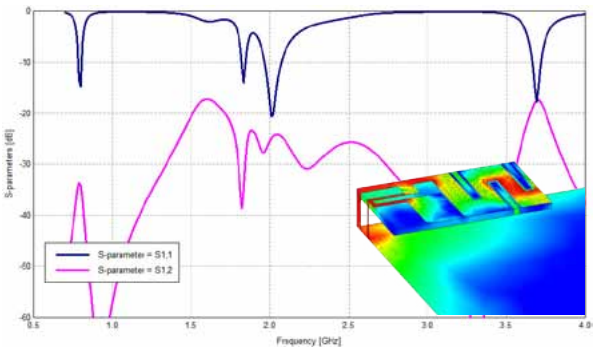


Far field radiation pattern at 1800 MHz. The model includes the mobile device, head and hand

Comprehensive Modeling, Simulation, Optimisation

Parametric modelling enables the user to build and subsequently change the design geometry to facilitate rapid and multiple prototype conceptualisation. The method of moments (MoM) solver provides fast and accurate simulations of initial designs which enable quick insight into the performance of prototypes. It allows for the early elimination of prototypes which do not satisfy the criteria. As the design cycle progresses, CAD import filters can be used to add mechanical data to the model (for example, device housing and components). Mathematical models are available to simulate material properties, such as dielectrics (for example, dispersive, anisotropic, metamaterials, frequency independent) and metals (for example, perfect electric conductor (PEC), lossy, magnetic, frequency independent). Throughout the design process, the multiple solvers in FEKO can be used for cross-validation of models and results.

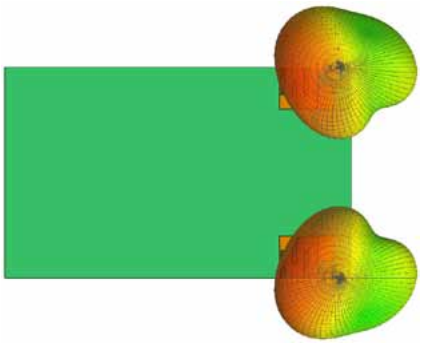
The optimisation platform is ideal for automated modification of the geometry to meet user-specified goals. For example, tuning the resonant frequencies of a multiband antenna or reducing the SAR at a given frequency while ensuring the total radiated power (TRP) remains acceptable.



S-parameters of a novel quad-band MIMO antenna [1] for long term evolution (LTE) and WiFi

Advanced Matching using Optenni Lab

Matching circuits for tuning the resonant frequencies and bandwidths of antennas designed in FEKO to exact requirements can be designed using the Optenni Lab software. The obtained matching network can be modelled as a non-radiating network in FEKO. It can be simulated together with the antenna geometry for accurate characterisation of the final prototype.



Far field radiation patterns for a novel quad-band MIMO antenna [1] for long term (LTE) and WiFi

Antenna Diversity and MIMO

Good port-to-port isolation is essential to achieve the required low correlation between closely spaced antennas for MIMO performance. S-parameter calculation is straightforward to determine with FEKO and the isolation can be set as a design goal during optimisation.

The Lua script environment offers a direct handle on simulation result data to perform custom data extraction routines. It allows for parameters like the mean effective gain (MEG) and envelope correlation coefficient (ECC) to be calculated and plotted directly in POSTFEKO.

SAR and OTA Compliance

Although SAR and OTA performances are often only tested near the final stage of the product development, FEKO offers an ideal platform for easy assessment early in the design cycle. Homogeneous hand and head (SAM) phantoms are available for studying realistic in-use scenarios. The inclusion and proximity of these loads will influence the antenna OTA and SAR performance. Little effort is needed to add the loads to existing models that have been set up to simulate the free space performance. By assessing compliance throughout the design, a more robust product can be developed. As a result, the final prototype is more likely to outperform requirements rather than fail the final compliance testing.

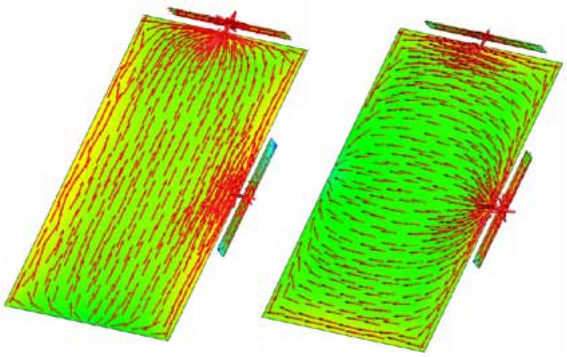
POSTFEKO Report Templates

Using report templates, consistent reports are generated by extracting defined quantities from simulation results and applying the styling from a Microsoft PowerPoint or Word template. Styled templates can be created to contain a specific theme, company logo and branding. A default FEKO template is available for the quick generation of a report containing all or a subset of the POSTFEKO views and graphs. With minimum input from the user, a professional report is generated that is ideal for design reviews or a prototype proposal.

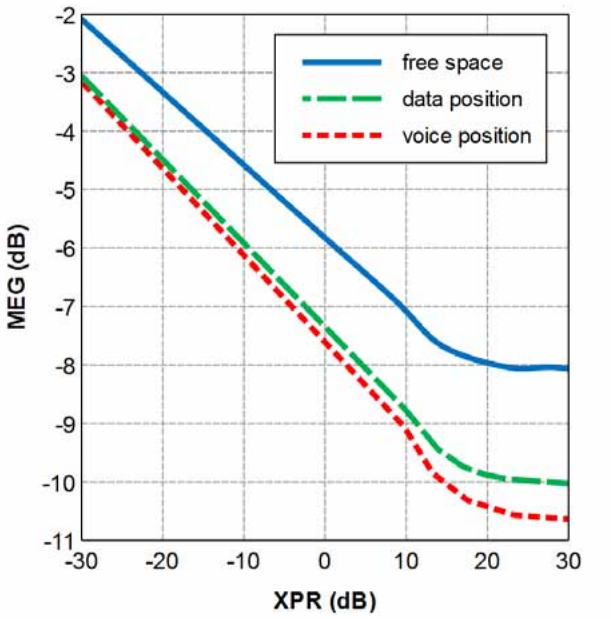
References

[1] M. K. Meshram, et al., A Novel Quad-Band Diversity Antenna for LTE and Wi-Fi Applications With High Isolation, IEEE Transactions on Antennas and Propagation, Vol. 60, No. 9, Sept. 2012.

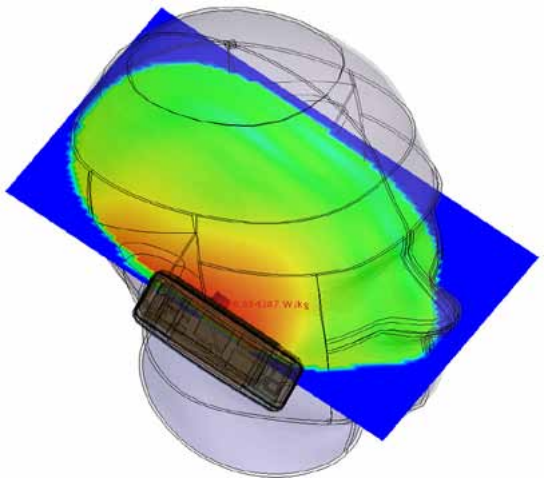
[2] P. Futter et al. Simulation Approach for MIMO Antenna Diversity Strategies, EDICON 2014.



The placement of two MIMO elements is optimised with CMA to improve isolation [2]



MEG at 3.65 GHz showing the drop in gain in the voice (against the head) and data (held with 2 hands) positions [1]



SAR distribution and SAR averaging enable pre-compliance design comparisons with FEKO

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