Defining antenna performance

TICRA ENABLES YOU TO CREATE, ANALYSE AND VALIDATE ANTENNA DESIGNS FASTER AND MORE ACCURATELY.

TICRA

Trusted antenna and EM modelling software

Catering to the global space industry, TICRA provides the tools needed to build and further develop an infrastructure in space. Our antenna and EM modelling software is used by every major player in the global satellite market.

TICRA is the leading provider of cutting-edge antenna modelling software for spacecraft operators and manufacturers, space agencies, Earth station and terminal suppliers, defence organisations, and research institutions.

Based in Copenhagen, Denmark, and with agents around the globe, TICRA's products are trusted worldwide as the industry standard for analysis and design of satellite antennas.

A history of excellence

TICRA was founded in 1971 to develop ways to accurately describe electro-magnetics phenomena, with a special focus on radiation from antennas for space applications. In 1976, TICRA created GRASP, the world's first commercial reflector antenna software, which has since evolved to become the fastest and most accurate tool for reflector antenna modelling and scattering analysis.

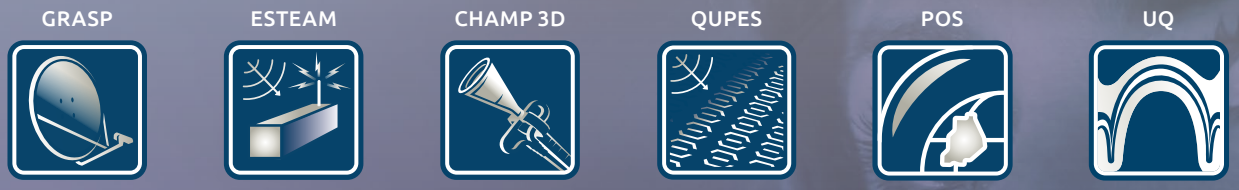
Building on this heritage, TICRA today offers a broad range of software products and consultancy services that enable businesses to streamline their development process. TICRA products give customers confidence that each antenna design is validated and fully optimised for its specific application.

ELECTROMAGNETIC RADIATION IS IN OUR DNA, AND AT THE HEART OF WHAT WE DO.

TICRA Tools

SEAMLESS INTEGRATION OF ANTENNA ANALYSIS AND DESIGN TOOLS

TICRA Tools



TICRA Tools is the most effective framework to simulate antenna performance during the early design phase, manufacturing, and even after implementation.

No matter if you work with large radio telescopes scanning the universe, complex satellite antennas that enable communications, or small terminals for internet access at sea, you have everything you need in a single, intuitive package.

TICRA Tools – key features and benefits:

- Six products, one user interface
- Use each product independently
- Synergy between products – combine methods and analyse efficiently
- Flexibly activate and deactivate products

www.ticra.com/ticratools

GRASP

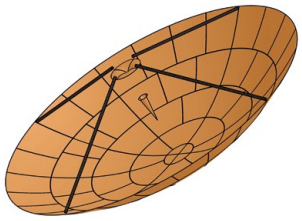
FAST AND ACCURATE DESIGN AND ANALYSIS OF COMPETITIVE REFLECTOR ANTENNA SOLUTIONS

FEATURES

- *Wizard for easy definition of single- and dual-reflector geometries*
- *Near-field and far-field calculations of vector fields*
- *Component library for common geometries, e.g. conic surfaces, general quadrics, radomes, panels, rectangular and circular struts*
- *Import of general reflector shapes from data files*
- *Component library of mathematical feed models*
- *Import of general feed definitions from file and expansion in spherical modes*
- *Easy definition and fast analysis of quasi-optical networks*
- *Fast and easy computation of power transmitted between two antennas*
- *Advanced GTD algorithm for large reflector and scattering problems*
- *BoR-MoM for full-wave analysis of rotationally symmetric reflectors and lenses*
- *Design tool for quasi-optical network*

BENEFITS

- *Seamless integration with other products in TICRA Tools*
- *Accurate analysis of reflectors*
- *Reliable results*
- *Easy to import feed data from other software vendors or test ranges*
- *Quick setup of complicated geometries*
- *Guided design of quasi-optical networks*

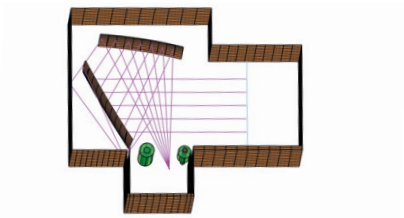


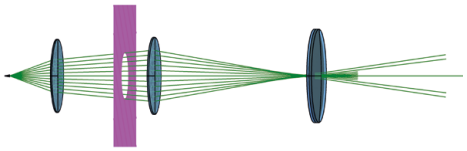
Analysis and design of reflector antenna systems

GRASP is a dedicated software package for reflector systems, and as such it offers fast and accurate analysis and design optimisation of even the most advanced reflector antenna systems. The efficient Physical Optics (PO) algorithm that GRASP is based on enables users to predict the entire pattern from very large antennas in a matter of seconds. Ray methods are also available as an alternative and may be used to visualise scattering paths.

Easy definition of single and dual reflector geometries with built-in wizard

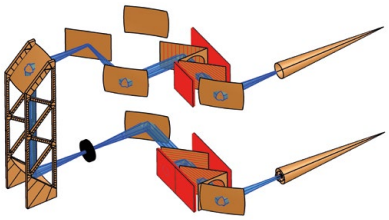
The intuitive wizard in GRASP allows for easy setup of single reflectors, Gregorian and Cassegrain systems as well as axially displaced dual reflectors. The wizard generates a template that can serve as a starting point for more elaborate investigation of antenna designs.





Large selection of feed models

Analytical feed radiation patterns as well as import from other analysis tools or measurements are supported. The most accurate predictions are obtained in conjunction with CHAMP 3D in TICRA Tools, which also enables feed design optimisation based on secondary far-field goals.



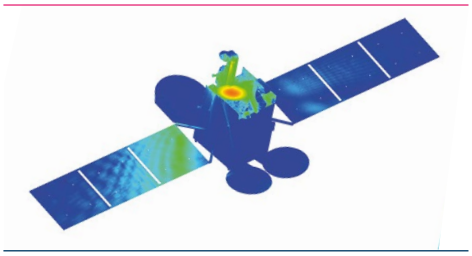
Quasi-optical network design

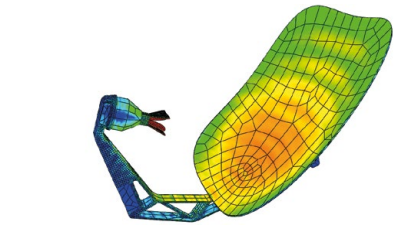
The GUI enables easy setup of beam-waveguides and quasi-optical networks consisting of feeds, plane and curved mirrors, beam-splitters, interferometers, and loads. These networks are first designed and sized by means of Gaussian beam theory, and may subsequently be analysed by PO, which offers accurate determination of de-polarisation and diffraction effects.

www.ticra.com/grasp

ESTEAM

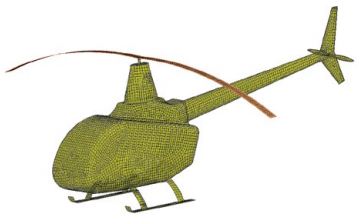
DESIGN OF GENERAL ANTENNAS AND SCATTERING BY LARGE STRUCTURES





General EM scattering and radiation

ESTEAM is the tool for solving electromagnetic scattering and radiation problems of general nature involving conducting as well as dielectric materials. Detailed models of, for example, microstrip and helix antennas can be analysed and optimised, and ESTEAM particularly excels for modelling electrically large antennas and platforms. ESTEAM also allows calculation of monostatic Radar Cross Section (RCS)*.



Flexible handling of complex geometrical models

Parametrised objects are available to build models of various geometries and antennas, and if combined with GRASP in TICRA Tools, a wide range of parametrised reflector geometries are also available. More complex structures may be imported through CAD files in STEP or IGES format, or through tabulated mesh files.

Platform scattering and antenna placement

Real-world antennas do not exist alone but are used in proximity to other antennas and often mounted on a structure or platform. Predictions of the antenna performance may depend critically on accurate modeling of this antenna placement, and ESTEAM is particularly well suited for analysing this. The antenna surroundings could, for example, include a mounting arm or an entire spacecraft with a multitude of reflector antennas, solar panels, thrusters and other mechanical structures.

Minimum memory requirement, maximum accuracy

The secret lies in decades of in-house R&D in MoM techniques using higher-order patches and current expansion functions combined with an accelerated method, MLFMM, tailored to the MoM algorithm. This ensures maximum accuracy with minimum memory consumption, while simultaneously achieving high speed.

www.ticra.com/esteam

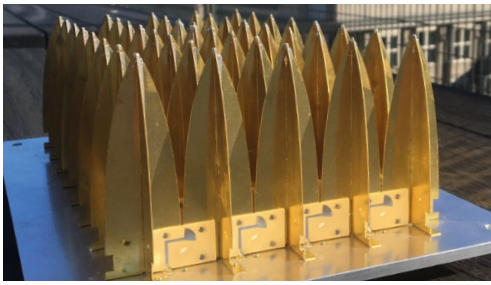
** Only available to users in selected countries.*

FEATURES

- *State-of-the-art higher-order MoM solver*
- *MLFMM implementation tailored to higher-order MoM*
- *Automatic meshing of imported CAD files*
- *Selection of parametrised geometries, including wires, boxes, BoR and clusters of any of these*
- *Waveguide ports, generators and measured patterns as excitations*
- *Analysis of structures with composite metallic, dielectric and magnetic materials*
- *Monostatic RCS**

BENEFITS

- *Seamless integration with other products in TICRA Tools*
- *Design, analysis and validation of complex antenna installations*
- *Higher accuracy and lower memory requirements than competing full-wave solvers*
- *Analysis of highly detailed models, providing better comparison with measurements*
- *Confidence in your design*



CHAMP 3D

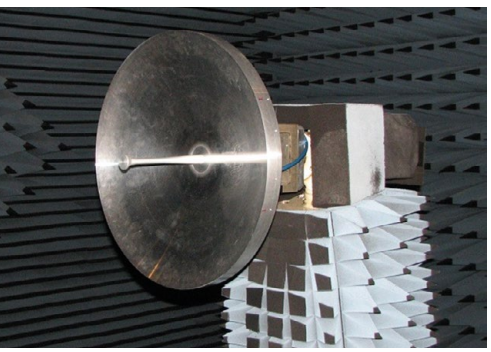
ANALYSIS AND DESIGN OF GENERAL PASSIVE MULTIPORT WAVEGUIDE COMPONENTS AND COMPLEX FEED CHAINS

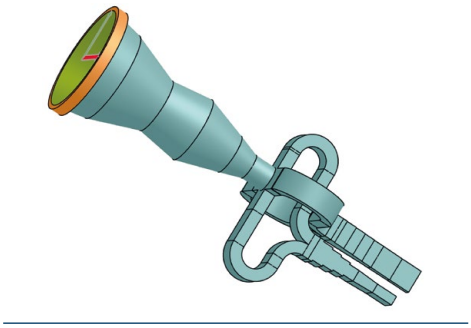
FEATURES

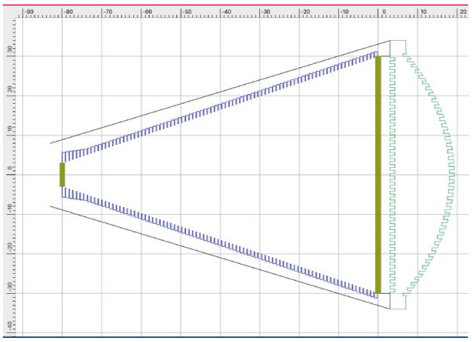
- *Calculate scattering parameters for passive metallic and dielectric waveguide components*
- *Calculate reflection coefficients/ scattering parameters and radiation patterns for rotationally symmetric and arbitrarily shaped feeds*
- *Fast recalculation of waveguide assemblies by use of the Generalized Scattering Matrix (GSM) approach for decomposing the assembly into smaller components*
- *The most appropriate solver (analytical expressions, mode matching, higher-order BoR-MoM, or higher-order 3D MoM) is selected for each component*
- *Dedicated wizard and 2D editor for easy geometry setup of corrugated horns, smooth-wall horns as well as rotationally symmetric single, dual, and ring focus reflectors*
- *Direct optimisation with goals on scattering parameters as well as primary and secondary radiation patterns*

BENEFITS

- *Seamless integration with other products in TICRA Tools*
- *Fast analysis and optimisation*
- *Feeds, waveguides, and reflectors can be analysed and optimized as a single model*







Built-in library of predefined components

In CHAMP 3D the user can build a complex 3D or rotationally symmetrical waveguide assembly or feed by selecting from a library of predefined components or load the assembly/component from a CAD file. Scattering parameters and radiation from feeds excited by arbitrary waveguide modes or any combination hereof can be calculated.

The components are analysed with the most appropriate solver, tailored to each component.

Simple setup of rotationally symmetric horns

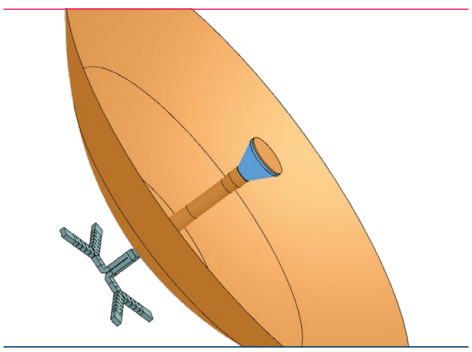
The dedicated 2D editor can be used for easy setup of axially or radially corrugated horns, smooth-wall horns as well as rotationally symmetric reflectors and VSATs.

Easy design optimisation

The optimisation algorithms available for any product in TICRA Tools offer both global and local methods for thorough design developments. S-parameters and return loss are typically considered in CHAMP 3D, just as the feed radiation may be formed to meet a specific pattern template. Rotationally symmetric terminals with one or two reflectors can be made to meet pattern constraints, e.g. side-lobe roll-off.

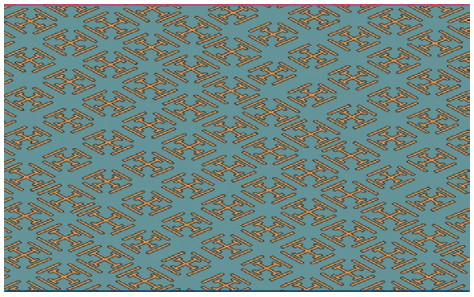
In conjunction with GRASP in TICRA Tools it is possible to optimise all the feed chain components in general antenna systems based on the final desired far-field performance rather than on a prescribed intermediate pattern.

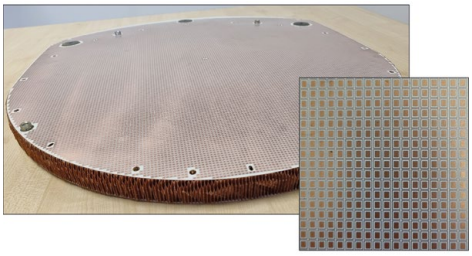
www.ticra.com/champ3d



QUPES

ANALYSIS AND DESIGN OF QUASI-PERIODIC SURFACES





QUPES is a dedicated software tool for analysis and design of quasi-periodic surfaces such as reflectarrays, frequency selective surfaces (FSS), and transmitarrays. Starting from the definition and design of the unit-cell geometry to the optimisation of the entire finite-sized structure, QUPES provides the needed capabilities to design a periodic/quasi-periodic surface in a single tool.

Optimisation of quasi-periodic surfaces

QUPES has unique capabilities that are not available in any other commercial software packages. In particular, the capability of optimising entire quasi-periodic surfaces directly for goals on the final radiation pattern. This allows the user to design advanced reflectarrays for applications such as synthetic aperture radars, deployable antennas on SmallSats, terrestrial applications for 5/6G, and much more.

Advanced reflector system designs

The capabilities in QUPES are seamlessly integrated with the other software products in TICRA Tools. This allows the user to design advanced high-performance reflector systems consisting of, for instance, periodic/quasi-periodic surfaces for multi-band antenna systems, for use on high-throughput satellites, ground stations, beam-waveguides, and quasi-optical networks.

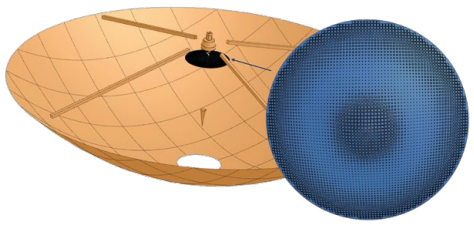
www.ticra.com/qupes

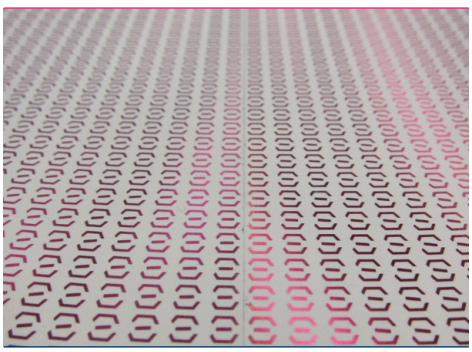
FEATURES

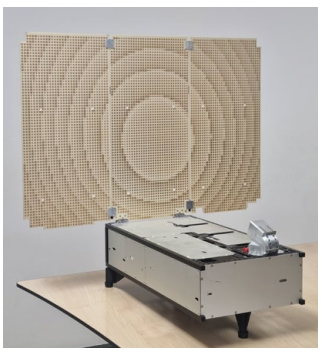
- *Analysis and optimisation of scattering parameters of periodic unit-cell structures*
- *Predefined library of commonly used geometries*
- *Dedicated methods for the analysis of periodic/quasi-periodic surfaces*
- *Features for multiple panels, holes, planar and curved surfaces*
- *Large-scale direct optimization of quasi-periodic surfaces for goals on primary as well as secondary radiation patterns*

BENEFITS

- *Seamless integration with other products in TICRA Tools*
- *Fast and accurate analysis of periodic/quasi-periodic surfaces*
- *Design of quasi-periodic surfaces in a single tool*
- *Provides designs with superior performances compared to traditional methods*
- *Can handle real-life applications*







POS

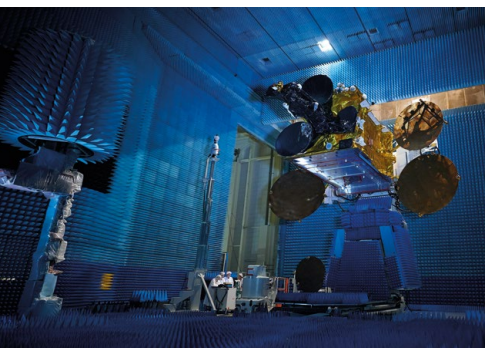
ADVANCED PAYLOAD ANTENNA DESIGN SOFTWARE

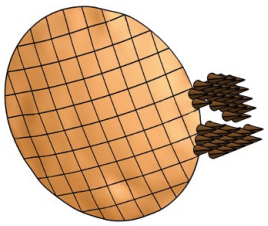
FEATURES

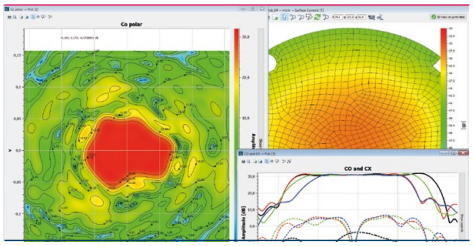
- *Shaping of single-, dual-, and multiple-reflector systems*
- *Array classes with full freedom of configuration for element positions and orientations*
- *Optimisation of array excitation coefficients*
- *Optimisation of array layout*
- *Optimisation goals for design of HTS antennas*
- *CAD export of shaped reflector surfaces*
- *Large selection of optimisation goals and algorithms*

BENEFITS

- *Seamless integration with other products in TICRA Tools*
- *Industry standard for design of contoured-beam reflectors*
- *Convenient and fast optimisation of direct-radiating arrays and array-fed reflectors*
- *Thoroughly tested by the space industry for decades*







Advanced payload antennas

POS enables the design of antennas for advanced payloads, such as reflectors for contoured beams, array-fed reflectors for High-Throughput Satellites (HTS), or reconfigurable direct-radiating arrays. POS has been relied upon by the global satellite industry for decades and is recognised as the de-facto standard for shaped reflector design. The software is also widely used for defining and optimising arrays and array-fed reflectors.

Optimisation of reflector surfaces

POS allows simultaneous optimisation of the shape of reflectors in single-, dual-, and multiple-reflector antenna systems. It is also possible to simultaneously optimise other parameters, such as reflector diameter and offset or angle between foci in dual reflectors.

The user can define manufacturer-imposed constraints on the shaped surfaces of reflectors, such as constraints on the curvature of the reflectors or constraints on the maximum displacement of the optimised surface from the original surface shape.

Optimisation of arrays

POS comes with several array classes that can be used for conveniently setting up arrays as well as effective algorithms for optimisation of array excitation coefficients. The optimisation of the coefficients can also be combined with optimisation of other array parameters, such as element positions and orientations. If POS is combined with CHAMP 3D or ESTEAM it is even possible to optimise the element geometry and the excitation coefficients simultaneously.

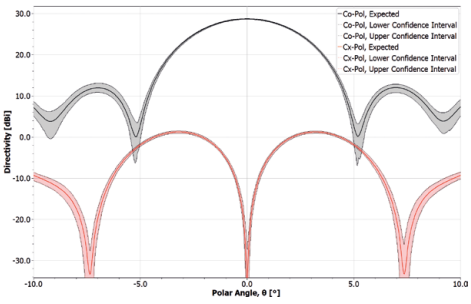
Easy setup of complex design goals

POS makes it possible to use the common TICRA Tools optimisation goals to define the targets for your design, as well as specialised goals only available in POS. These include the use of stations exported from SATSOFT or generated elsewhere to define coverage areas or isolation requirements. There is also a specialised goal for optimisation of HTS antennas that allows the user to set targets for carrier-to-interference ratio (C/I) in the beams.

www.ticra.com/pos

UQ

QUANTIFY UNCERTAINTIES OF YOUR ANTENNA PERFORMANCE



Uncertainty quantification

With the Uncertainty Quantification (UQ) product, the antenna designer may augment the usual antenna design process with uncertainties on design parameters and get data on the expected antenna performance and confidence intervals.

Uncertainty due to any parameter

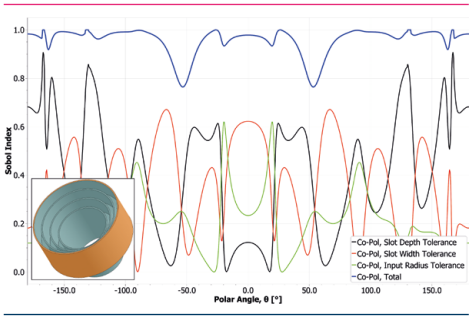
The UQ product may be used to estimate the uncertainty due to any parameter describing the antenna. Parameters may include geometrical dimensions, positions of elements of the antenna, surface distortions, material parameters, array excitation coefficients, and many more.

Easy integration with other TICRA software products

UQ is integrated in the TICRA Tools software framework. This means that you may quantify uncertainties for any antenna system modelled with one or more of the TICRA Tools antenna products, GRASP, ESTEAM, CHAMP 3D, QUPES, and/or POS.

Design parameters contributing most to uncertainty

In UQ, the so-called Sobol indices provide data on the partial contribution from each design variable to the uncertainty, which allows the antenna designer to identify the most critical design parameters. For any UQ output, Sobol indices due to each uncertainty parameter are computed.



Accurate uncertainty estimates in a reasonable time

While conventional approaches are typically either overly conversative or slow, TICRA's UQ employs a higher-order approach and thus provides accurate uncertainty estimates in a reasonable time, allowing the antenna designer to avoid overdesigning and achieve tighter margins.

www.ticra.com/uq

FEATURES

- *Simulate expected performance with confidence intervals of antenna radiation patterns and scattering parameters*
- *Uncertainty due to any parameter, such as manufacturing tolerances and alignment or excitation errors*
- *Accelerated Monte Carlo, Stochastic Collocation, and Polynomial Chaos Expansion algorithms to quantify uncertainties*
- *Sobol indices, to identify parameters contributing most to the total uncertainty*
- *Sensitivity analysis*

BENEFITS

- *Seamless integration with TICRA Tools products*
- *Insights to do more robust antenna designs*
- *Fewer design iterations and better antenna prototypes*
- *Avoid overdesign and achieve tighter margins*
- *Better correlation of measurements and simulations*
- *More general and powerful than sensitivity analysis in competing tools*

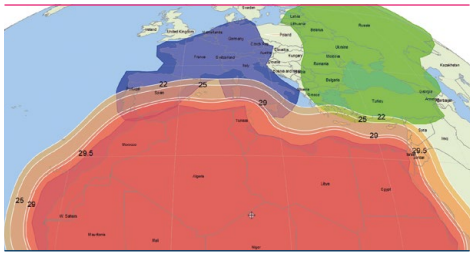
Mission planning and analysis

The Earth seen from space is a key visual when planning future satellite services; being able to select the intended service regions or countries should be no further away than a mouse-click.

SATSOFT offers this capability, combined with numerous options for generating and displaying antenna patterns to fulfill performance requirements. Equipped with a customisable database of cities on the globe, performance tables are easily generated to thoroughly inspect the performance of a given satellite antenna anywhere in the service area. Both service providers and antenna designers will benefit from the intuitive GUI offering vast antenna pattern display capabilities.

SATSOFT

EASY ASSESSMENT OF ANTENNA COVERAGE AND GAIN, DEVELOPMENT OF CONTOURED BEAM AND MULTI-BEAM ANTENNA DESIGN

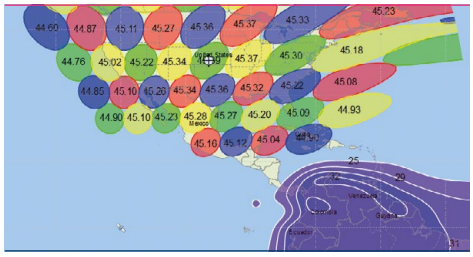


Pattern visualisation and coverage polygons

Supplier-furnished antenna patterns can be imported and managed with the Pattern Data Manager and subsequently inspected and visualised on a world map, while coverage polygons can be defined and displayed on the map. SATSOFT gives advanced features such as accounting for pointing error and edge of coverage contours.

Large selection of antenna models

SATSOFT offers import of antenna patterns and fast modelling using Gaussian beams with prescribed footprints. The optional Payload Antenna Planner (PAP) add-on adds physical optics analysis of array-fed offset reflectors and shaped reflectors as well as analytic direct radiating phased arrays, taking the design and analysis one step closer to real payload performance.



Postprocessing with Performance Tables and Delta Pattern

Imported pattern data as well as patterns generated with the built-in antenna models can be inspected and post-processed in several ways in SATSOFT. Cities selected from the supplied city database can be added to the map, including pointing error, and a Performance Table can be generated to tabulate directivity, EIRP, and minimax as a function of pointing, among others. Similarly, all antenna patterns can be compared directly by generating their difference in dB using the Delta Pattern feature.

Increased productivity with easy data export to other TICRA programs

With SATSOFT, you can easily export station files to be used for optimisation in POS. It is also possible to export complete reflector configurations set up in SATSOFT for further optimisation in POS or analysis in GRASP, considerably speeding up the design workflow.

Pattern contour and polygon export

Pattern contours and polygons can be exported from SATSOFT in numerous formats. Displayed pattern contours can be exported to ITU GXT format, while they can also be exported in KML format for display in Google Earth with its vast rendering capabilities. Similarly, coverage polygons can be exported for use in other SATSOFT projects and with STK, among others.

FEATURES

- *Quickly select countries or draw polygons to use as coverage area definition*
- *Synthesise contoured and spot beams with or without pointing error from reflector or array antennas*
- *Plot pattern contours and create performance tables of directivity, EIRP, and G/T*
- *Import measured or predicted antenna patterns for use in your analysis*

BENEFITS

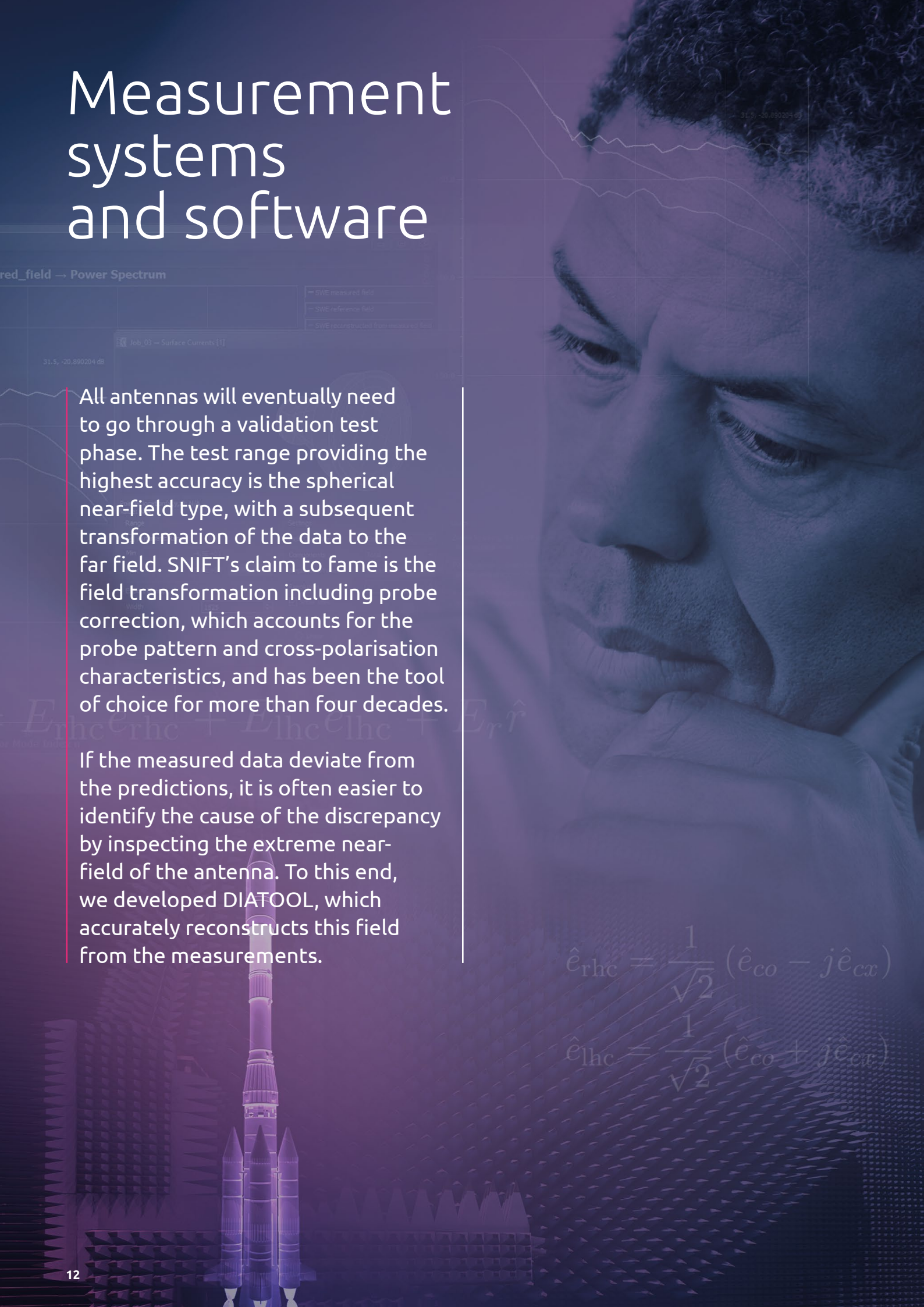
- *Efficient planning, designing, and marketing of communication satellite payloads*
- *Conduct antenna trade-off studies*
- *Prepare documents for ITU regulatory filings*
- *Intuitive user-interface*
- *Easy interface to POS and GRASP*

www.ticra.com/satsoft

Measurement systems and software

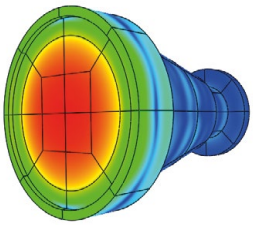
All antennas will eventually need to go through a validation test phase. The test range providing the highest accuracy is the spherical near-field type, with a subsequent transformation of the data to the far field. SNIFT's claim to fame is the field transformation including probe correction, which accounts for the probe pattern and cross-polarisation characteristics, and has been the tool of choice for more than four decades.

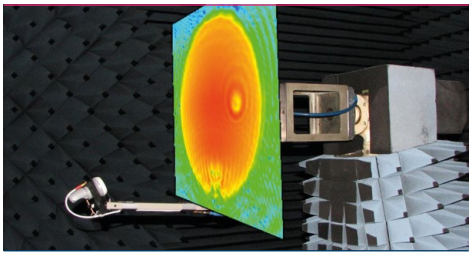
If the measured data deviate from the predictions, it is often easier to identify the cause of the discrepancy by inspecting the extreme near-field of the antenna. To this end, we developed DIATOOL, which accurately reconstructs this field from the measurements.



DIATOOL

DIAGNOSTICS TOOL TO INVESTIGATE YOUR ANTENNA'S FUNCTIONALITY FROM MEASUREMENTS





DIATOOL for advanced near-field test ranges

To assist test-range staff and antenna designers in identifying the origin of possible discrepancies in the designed and measured far-field patterns, DIATOOL works with the measured complex data (amplitude and phase) to view currents on the antenna under test (AUT) or on a surface enclosing the antenna.

This procedure helps engineers to accurately reconstruct the extreme near field and surface currents of an AUT from the radiated field measured in anechoic chambers. Inspection of the extreme near field and currents allows quick identification of electrical or mechanical errors in the antenna, which cause anomalies in the measured field, saving valuable time and resources in the antenna design and validation process.

FEATURES

- *Reconstruct the extreme near field with a resolution better than half a wavelength*
- *Planar reconstruction for fast analysis of large antennas; inverse MoM for higher resolution*
- *Definition of the AUT geometry by CAD or mesh file import*
- *Automatic generation of reconstruction surface through best-fit canonical surfaces, CAD or mesh files*
- *Visualisation of reconstructed currents over AUT surface*
- *Compatible with most near-field and far-field range data formats*

BENEFITS

- *Early detection and location of antenna anomalies*
- *Remove noise from measurements by filtering*
- *User-friendly interface*

SNIFT

SPHERICAL NEAR-FIELD FAR-FIELD TRANSFORMATIONS WITH FULL PROBE CORRECTION

SNIFT is the indispensable software constituent in spherical near-field test ranges, with the primary function to perform fast and accurate transformations of an antenna's field from one imaginary spherical surface to another, with the far-field sphere being a special case.

FEATURES

- *Allows full-sphere or partial-sphere input data*
- *Full correction for axially symmetric (m=±1) probes*
- *Fast Fourier Transformation and self-stabilising recurrence relations allow handling of even very large antenna structures*
- *Industry standard for spherical near-field to far-field transformation with probe correction*
- *Independent of the actual measurement system implementation*

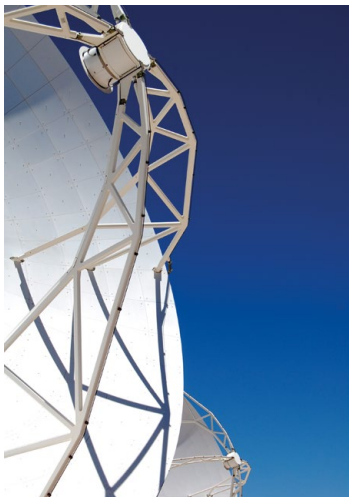
BENEFITS

- *Short transformation time*
- *Mathematically exact pattern transformation*
- *The output coordinate system may be rotated to coincide with the peak direction of the far field, which is not always coinciding with any of the measurement coordinate system axes*
- *Non-Maxwellian measurement inaccuracies are averaged to physically correct output*
- *Noise reduction by means of high-order spherical mode filtering*

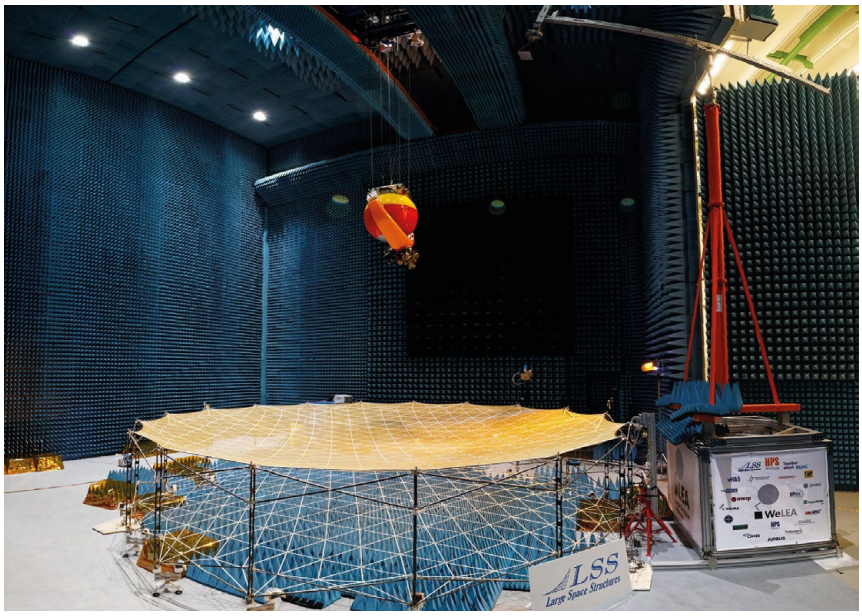
Services and support for your antenna design and analysis tasks

Whether you need consultancy assistance, software training, or you have technical support questions, our Applied Electromagnetics team will assist you in all issues regarding antenna design and analysis applications.

To ensure maximum uptime for our customers, our skilled experts strive to deliver the best possible service and support. They are deeply involved in the ongoing development of the software, and they all have profound experience with all TICRA software from their comprehensive work as consultants and researchers. As such, they are committed to respond promptly and provide high-quality service and support to customer requests.



Large European Antenna (LEA) by LSS and HPS, ©Airbus



Consultancy

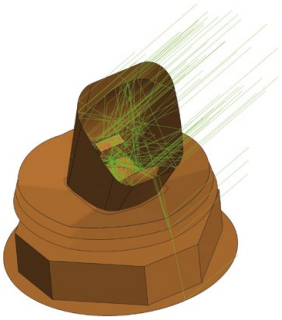
Whatever antenna design and analysis challenges you face, we are committed to resolve them quickly and effectively. Our skilled team of engineers can assist with, for example, reflector systems and VSAT design and analysis, feed horn design and scattering analysis as well as reflectarray and FSS design.

Software training

TICRA offers software training tailored to meet your specific needs. For new employees, training can help shorten the learning curve considerably, and for specialists, training offers the opportunity to keep up with the latest technology.

Technical support

All new software licenses include one year of Technical Support and Maintenance. This service includes expert help in the use of the software with 24-hour response time from Monday through Friday, as well as immediate access to new features and enhancements when a new software version is released.



Technical Support and Maintenance contract

Our Technical Support and Maintenance (TSM) contract keeps your EM software up to date and provides access to technical support by our experts when you need it.

All new software licenses include one year of TSM, which provides the following:

- Access to the newest functionality
  Our antenna engineering experts constantly develop new functionalities to improve the software based on customer feedback and industry needs. Therefore, you get immediate access to new features and enhancements when a new software version is released.

- Support with priority
  With a TSM contract you have access to experts who will provide technical support when you need it, to help you run processes efficiently.

Technical support is provided to the latest released version only.

TO ENSURE MAXIMUM UPTIME FOR OUR CUSTOMERS, OUR SKILLED EXPERTS STRIVE TO DELIVER THE BEST POSSIBLE SERVICE AND SUPPORT.

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