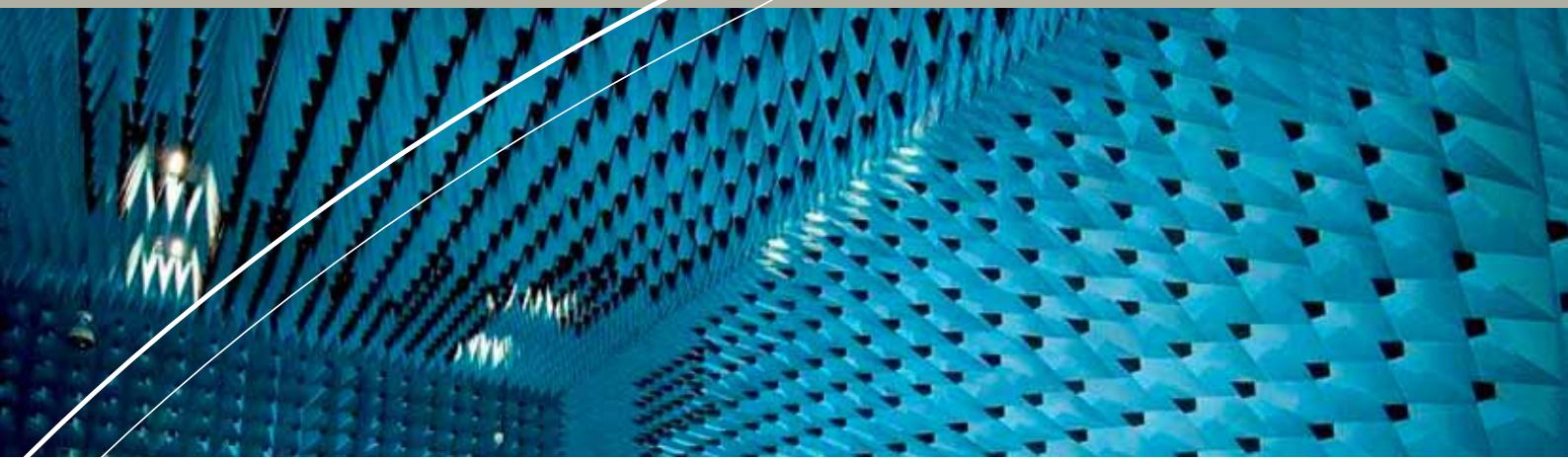
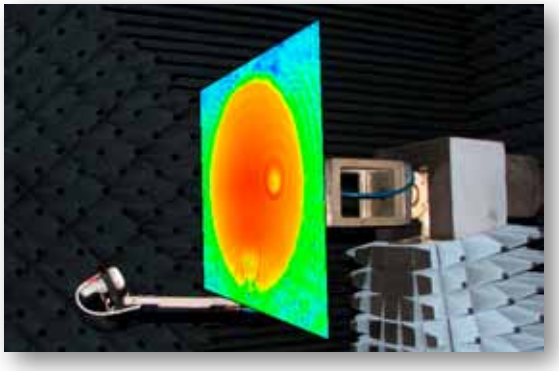
DIATOOL



The invaluable tool for advanced antenna diagnostics and processing of measured fields

DIATOOL accurately reconstructs the extreme near-field and surface currents of an antenna under test (AUT) from the radiated field measured in anechoic chambers.
The reconstruction is performed on an arbitrary surface enclosing the AUT and, if desired, conformal to it, or on a plane in the extreme near-field region.

The inspection of the extreme near-field and currents allows one to quickly identify the electrical or mechanical errors in the antenna which cause undesired anomalies in the measured field, saving valuable time and resources in the antenna design and validation process.



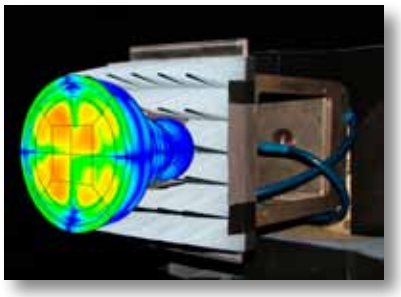
Application of the planar reconstruction: the co-polar component of the radiated electric field is reconstructed on a plane in the measurement coordinate system. A bump on the reflector surface is clearly visible. The bump caused numerous ripples in the side lobes of the measured far-field pattern, while the main lobe did not show any anomaly.

Application areas:

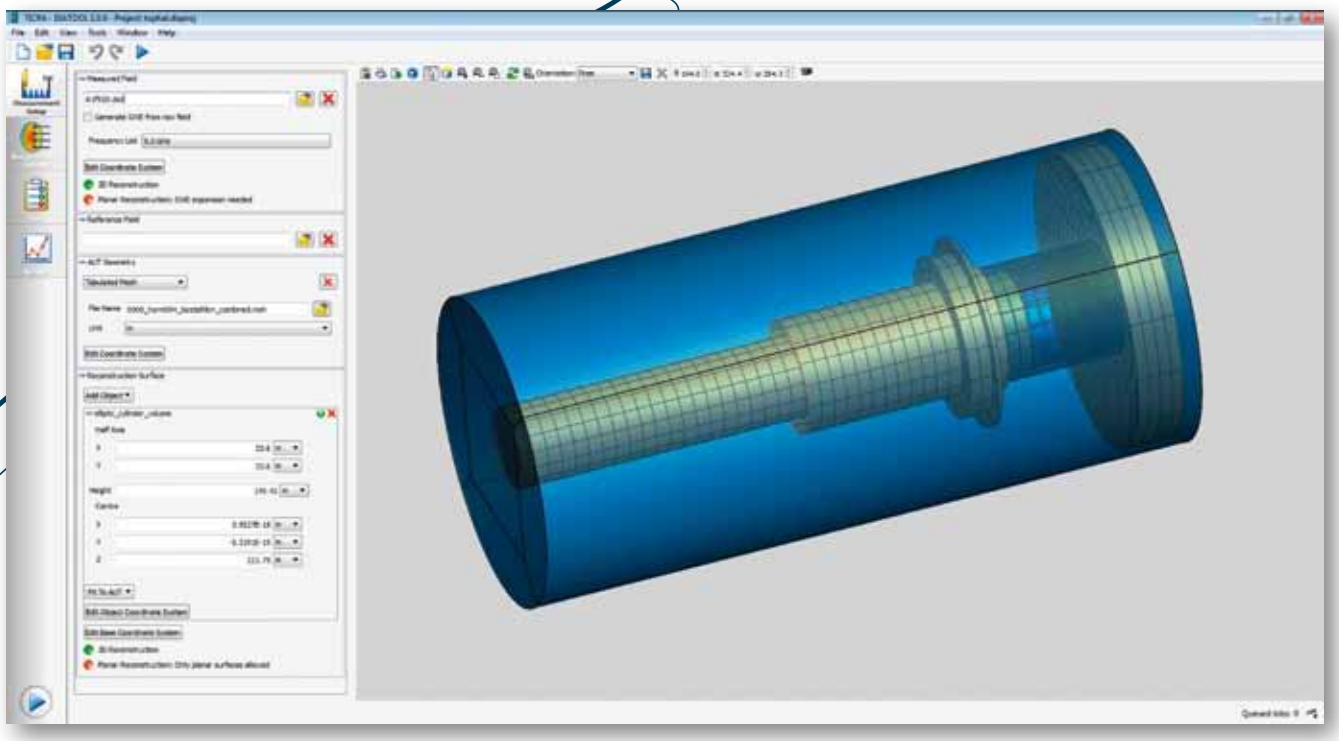
• ***Antenna diagnostics:***
Identification of array element failure, surface errors, feeding network and radome imperfections, leaking cables and bright spots generating unexpected anomalies in the radiation pattern

• ***Filtering of undesired radiation:***
Computation of clean antenna patterns where currents on cables, mounting fixture or selected areas of the reconstruction surface are suppressed - essential for measurements of small antennas

• ***Enhancement of measured patterns:***
Compute noise-free patterns radiated by the reconstructed currents - the conformal reconstruction surface acts as a physics-based filter that includes the shape of the AUT



Application of the 3D reconstruction: the cross-polar component of the radiated electric field is reconstructed on a closed surface conformal to the AUT. The figure shows an unexpected asymmetry which is due to an error in the horn feeding network and which causes a high cross-polar component in the measured pattern.



The DIATOOL GUI – Measurement Setup editor: the AUT is imported as a meshed geometry and the reconstruction surface is auto-defined as a cylinder enclosing the AUT.

Two reconstruction methods:

• ***3D reconstruction:*** this technique makes it possible to reconstruct field and surface currents on arbitrary 3D surfaces enclosing the AUT, including conformal surfaces when necessary. The MoM-based implementation features the most memory-efficient algorithm available on the market which allows even fairly large antennas to be treated on a laptop.

• ***Planar reconstruction:*** a modal approach involving a spherical wave-to-plane wave transformation, possibly taking into account part of the evanescent waves of the plane wave spectrum. The field is reconstructed on planar surfaces in front of or around the AUT. The algorithm is very fast and allows electrically large antennas to be treated with low memory requirements.

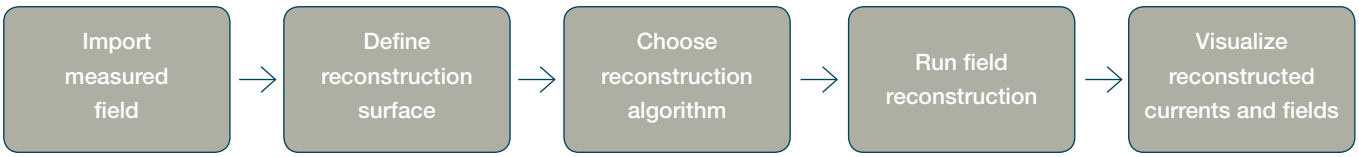
Capabilites of the 3D reconstruction:

1. Input measured field (in amplitude and phase) on any acquisition surface, including truncated and irregular surfaces
2. Field reconstruction on arbitrary surfaces enclosing the AUT and, if desired, conformal to it
3. Applicable to electrically small and medium-sized antennas
4. Effective memory use

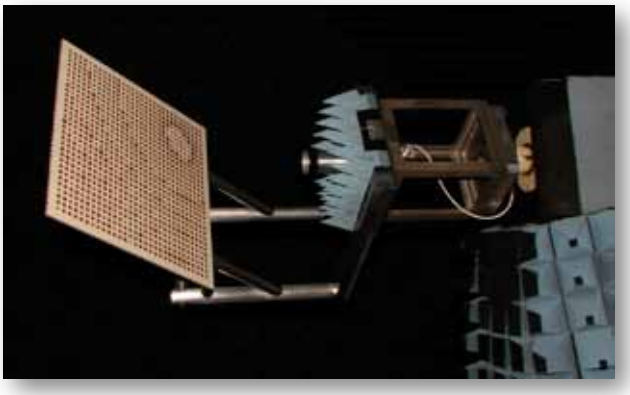
Capabilities of the planar reconstruction:

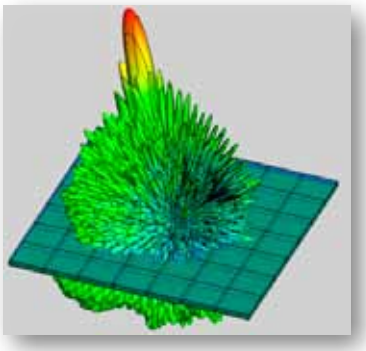
1. Input measured field (in amplitude and phase) on a full sphere
2. Field reconstruction on a plane or combination of planes
3. Applicable to both electrically small and large antennas
4. Extremely fast computation with low memory requirements

Both techniques theoretically provide very high resolution in the reconstructed field while the resolution in practical cases is limited by the SNR of the measured data. The 3D reconstruction technique always provides a resolution equal to or better than the traditional half-a-wavelength.

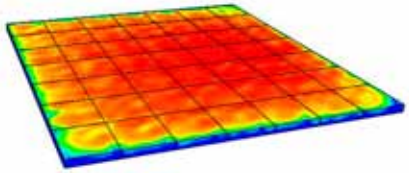


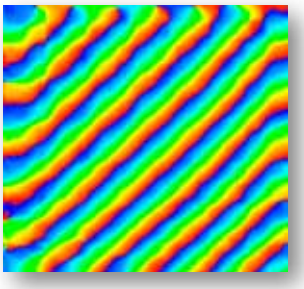
A typical field reconstruction flow with DIATOOL: in a few steps the reconstructed field is obtained.





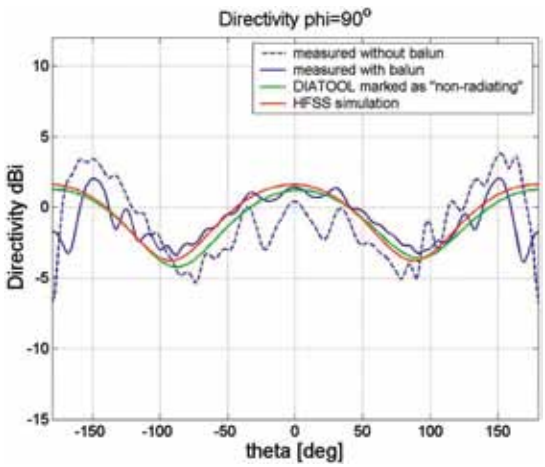
Courtesy of Technical University of Denmark.





X-band reflectarray (435 mm X 435 mm) with 900 elements designed for 45-degree beam tilt and very high edge illumination, see the figures at the top, working at 10 GHz (wavelength λ=30 mm). The 3D algorithm is used to reconstruct the field on a box enclosing the AUT, 14.5 λ X 14.5 λ X 0.5 λ. The reconstructed co-polar component on the top face of the box is shown in amplitude (on the left) and phase (on the right). The expected linear phase is perfectly reconstructed. The computation takes 10 minutes on a portable PC.

Courtesy of Technical University of Denmark.

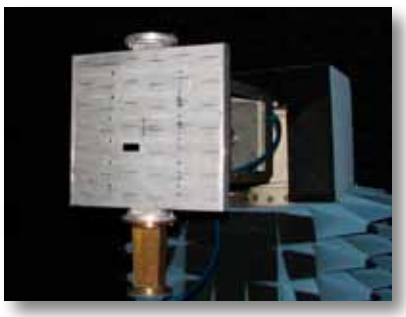


A printed loop antenna for hearing aids applications (35 mm X 10 mm) working at 920 MHz was measured with a supporting arm 135 cm long, with and without a balun, see pictures on top. The measured directivities (continous and dashed blu curves) were compared with the expected directivity (red curve): the agreement was not excellent, though the measurement with a balun was definitely more accurate than the one without balun. The 3D algorithm was then used to reconstruct the currents on a closed surface conformal to the antenna with supporting arm, see picture above, from the field measured with a balun. The currents on the supporting arm were finally marked as "non-radiating" and only the currents reconstructed on the small box enclosing the antenna were used to compute the directivity (green curve). The agreement with the expected directivity is high. The computation takes 40 seconds on a portable PC.

DIATOOL

DIATOOL features:

- Appealing and easy-to-use interface to set up the problem and visualize the computed results
- Compatible with most near-field range data formats
- CAD and mesh file import of the AUT geometry and reconstruction surface
- Automatic generation of the reconstruction surface through canonical surfaces, such as boxes, ellipsoids, elliptic cylinders, piecewise linear bodies of revolution
- Two accurate reconstruction techniques, for electrically small and large AUTs and general measurement acquisition surfaces
- Filtering of the reconstructed currents and possibility of marking parts of the reconstruction surface as perfectly conducting
- Evaluation of the field radiated by the reconstructed currents on any point outside the reconstruction surface
- Supported and maintained by the dedicated TICRA crew - just like the rest of our advanced software



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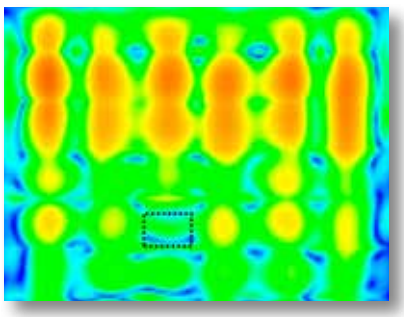
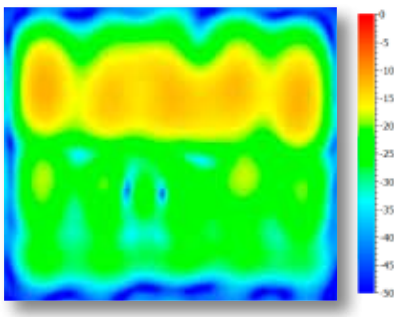
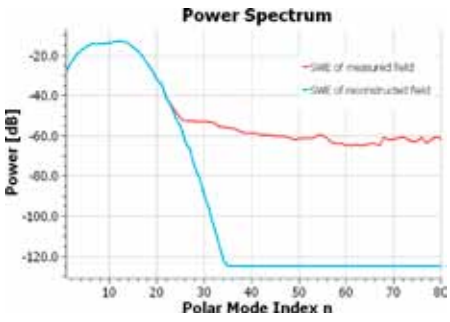


DIATOOL 3D reconstruction.



Traditional microwave holography.

A 6 X 7 slotted waveguide array of dimensions 30 cm X 27 cm working at 5.25 GHz, with different row excitations and a conductive tape covering one slot. The amplitude of the co-polar component of the tangential electric field obtained with the 3D reconctruction is shown above in dB scale: all 42 slots are visible, along the columns and rows. It is also noted that the slot rows 2 and 3 are strongly excited whereas rows 6 and 7 are very weak. Moreover, the slot covered by conductive tape is clearly identified. In the figure above on the right the same field component in the same dB scale obtained by traditional microwave holography is shown: the 42 slots cannot be resolved.
The resolution provided by the 3D algorithm is far higher than the traditional half-a-wavelength.
Finally, the spherical wave expansion (SWE) of the reconstructed field is plotted together with the measured SWE, see picture to the right: the reconstructed currents provide a noise-free pattern.



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TICRA is an antenna engineering company with world leading expertise in software tools and consultancy services within design, analysis and measurement techniques for antennas. Based in the centre of Copenhagen, Denmark, TICRA employs highly skilled professionals with over 240 man-years of expertise in their fields.

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