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Light Scattering by Systems of Particles

Null-Field Method with Discrete Sources – Theory and Programs

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The **CD-ROM** with the book includes the following **FORTRAN90** programs:

The main program `TMATRIX.f90` calls a **T**-matrix routine for solving a specific scattering problem. These routines compute the **T** matrix of

- homogeneous, dielectric (isotropic, chiral) and perfectly conducting, axisymmetric particles (`TAXSYM.f90`),
- homogeneous, dielectric (isotropic, uniaxial anisotropic, chiral) and perfectly conducting, nonaxisymmetric particles (`TNONAXSYM.f90`),
- axisymmetric, composite particles (`TCOMP.f90`),
- axisymmetric, layered particles (`TLAY.f90`),
- an inhomogeneous, dielectric, axisymmetric particle with an arbitrarily shaped inclusion (`TINHOM.f90`),
- an inhomogeneous, dielectric sphere with a spherical inclusion (`TINHOM2SPH.f90`),
- an inhomogeneous, dielectric sphere with an arbitrarily shaped inclusion (`TINHOMSPH.f90`),
- an inhomogeneous, dielectric sphere with multiple spherical inclusions (`TINHOMSPHREC.f90`),
- clusters of arbitrarily shaped particles (`TMULT.f90`),
- two homogeneous, dielectric spheres (`TMULT2SPH.f90`),
- clusters of homogeneous, dielectric spheres (`TMULTSPH.f90` and `TMULTSPHREC.f90`),

- concentrically layered spheres (TSPHERE . f90) and
- a homogeneous, dielectric or perfectly conducting, axisymmetric particle on or near a plane surface (TPARTSUB . f90).

The program

- performs convergence tests and write the results to the output file /OUTPUTFILES/Output .dat,
- computes and stores the T matrix in the file /TMATFILES/FileTmat, and
- compute the scattering characteristics and write the results to the files /OUTPUTFILES/FileDSCS and /OUTPUTFILES/FileScat.

Three other routines are called by the main program:

- SCT . f90 computes the scattering characteristics of a particle using the previously calculated T matrix,
- SCTAVRGSPH . f90 computes the scattering characteristics of an ensemble of polydisperse, homogeneous spherical particles, and
- EFMED . f90 computes the effective wave number of a medium with randomly distributed spheroidal particles.

Detailed descriptions of the routines invoked by the main program are given in the comment lines included at the top of each routine.

Specific **T**-matrix calculations are performed by several routines which are included in the following files:

- AdditionTh . f90 provides routines for computing the translation addition coefficients, the rotation functions and the coupling coefficients,
- BesLeg . f90 contains routines for computing the spherical Bessel and Hankel functions, the cylindrical Bessel functions and the associated Legendre functions,
- Check . f90 provides routines for checking the input data,
- GeomLib . f90 is a library of particle geometries,
- GeomTrans . f90 provides routines for geometric transformations,
- IncCoeff . f90 contains routines for computing the incident field coefficients for a vector plane wave and a Gaussian beam,
- InputOutput . f90 supplies routines for reading and writing the data,
- Integr . f90 provides numerical integration routines,

- `Interp.f90` supplies interpolation routines,
- `MachParam.f90` contains routines for computing the machine constants,
- `MatrixOp.f90` provides routines for performing elementary matrix operations,
- `MatrixQ.f90` contains routines for computing the (partial) Q matrices and the incident matrices at a specific integration point,
- `MatrixSolv.f90` supplies routines for solving linear algebraic equations,
- `MatrixTrans.f90` provides matrix transformation routines,
- `Parameter.f90` defines the constant parameters of the codes,
- `PostProces1.f90` and `PostProces2.f90` provide routines for computing the scattering characteristics for a particle in a fixed or a random orientation,
- `PostProces3.f90` provides analytical size averaging routines for spherical particles,
- `Proces1.f90` supplies routines for computing the complete Q matrices and the incident matrices for axisymmetric and nonaxisymmetric particles,
- `Proces2.f90` supplies routines for computing the complete Q matrices and the incident matrices for composite and layered particles,
- `Proces3.f90` supplies routines for computing the scattered field coefficients for spheres and the complete Q matrices for uniaxial anisotropic particles and particles on or near a plane surface, and
- `SVWF.f90` provides routines for computing the localized and distributed vector spherical wave functions.