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# A semi-automated procedure for the alignment and the overlap function estimation of stepper motor controlled lidars

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Lidar observations are fundamental to quantitatively study the vertical distribution of atmospheric aerosols. In particular, some applications (e.g. air quality monitoring) need the description of the particulate from the ground up to the top of the atmospheric boundary layer. To correctly interpret the received lidar signal in the lowermost range, where the overlap between the telescope field of view and the laser beam is incomplete, an optimized alignment and the knowledge of the overlap function are required.

The multi-wavelength multi-telescope RMR “9-eyes” system in Rome Tor Vergata [1] has the capability to move, through electronically controlled stepper motors, the orientation of the laser beams and the 3D position of the diaphragm of the receiving optical system around the focal point of the telescopes. Taking advantage of these instrumental characteristics, a set of semi-automated tools (the *mapping* procedure) was developed for the optimization of the telescope/beam alignment and the estimation of the overlap function.

In this study the results of the *mapping* applied to a single combination of telescope-laser beam are reported. To demonstrate the effectiveness of the procedure the results were verified by comparing the whole profile of the signal and the outcome of the *telecover* test [2] before and after the alignment. The overlap function was estimated and the height of full overlap compared against the one obtained from a geometric model.

The proposed method gives the possibility to characterize the signal profile as a function of the position of the receiving optical system in the 3D space around the focal point. This characterization improved the accuracy of the system alignment protocol. The *mapping* applied to the laser beam can be used to align systems with fixed receiving geometry and, as presented, to estimate the overlap function.

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