Purpose:To provide an efficient cloud computing infrastructure for VMAT and IMRT inverse planning.

Methods:Amazon Elastic Compute Cloud (EC2) with a master node (17.1 GB memory, 2 virtual cores, 420 GB instance storage, 64-bit platform) is used as the backbone of cloud computing for VMAT and IMRT dose optimization. The master node is scalable on an "on-demand" basis. It can lunch more workers if the CPU usage exceeds the upper limit for given time (e.g., over 90% usage for 2 minutes), or terminate the workers if there are finished tasks. A quadratic objective function with volumetric constraints is expressed as a function of the aperture shapes and weights of the incident beams. A Monte Carlo simulation is employed to generate accurate dose kernel by parallel tasks. The number of parallel tasks is approximately the same as or less than the total number of beamlets in iterative simulation for all beams. The cloud optimization is implemented for a Varian TrueBeam STX linac beams with and without flattening filters available. The filed output from EC2 is sent down to the Simple Storage Service (S3). Three clinical cases have been studied for the purpose of evaluating the performance of the new planning platform.

Results:A cloud computing environment leads to speedups of 150-300 times for the cases considered in this study. The speedup scales approximately linearly with the number of nodes used for computing. The resultant plans from the cloud computing are found almost identical to that obtained using a desktop PC, indicating the reliability of the cloud computing platform.

Conclusions:A cloud computing infrastructure has been established for VMAT and IMRT inverse planning with different beam characteristics. The cloud computing environment substantially improves the speed of inverse planning and makes future on-treatment adaptive replanning possible.

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