

**AbstractID: 13551 Title: Medical physics calculations in the Cloud: a new paradigm for clinical computing**

**Purpose:** The accuracy of medical physics calculations is largely limited by the availability of fast computer hardware, which is in turn strongly limited by budget considerations. This research explores the use of the Cloud Computing paradigm to replace or supplement existing computing infrastructure for medical physics calculations. Cloud computing services allow for on-demand virtual computing clusters with a pay-as-you-go pricing model. This model has the potential to make large scale Monte Carlo simulations routine in clinical and research activities.

**Methods and materials:** To test the feasibility of medical physics calculations in a cloud computing environment, a distributed Monte Carlo dose calculation framework was implemented with Amazon's EC2 cloud computing service, the Fluka 2008.3b Monte Carlo package, a distributed processing framework written in Python, and the Hadoop MapReduce framework. A variety of relevant calculations were performed: depth dose profiles of proton, electron, and photon beams, along with a simple proton treatment plan using a voxel patient geometry (Zubal phantom). The performance of EC2 was tested by running calculations on 1 to 200 virtual nodes with the different distributed processing frameworks. EC2 prices were compared with costs of comparable local hardware.

**Results:** Relevant medical physics calculations were successfully carried out using the EC2 service. Heavy charged particle, electron, and photon depth dose profiles and a simple treatment plan were successfully calculated remotely. Performance data demonstrated the expected  $1/n$  speed-up as a function of node number. Two different distributed processing schemes were implemented in the cloud.

**Conclusion:** Our implementations demonstrate the power of the existing cloud computing model. The relatively cheap pay-as-you-go pricing for infrastructure on demand offers an extremely promising new paradigm for clinical and research computing, available to anyone with a network connection.