

Compressed Sensing Algorithms for Group Testing of Pooled Samples

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Specific problem being addressed The COVID-19 crisis has severely affected several parts of the world including India. During the spike of COVID-19 infection there was a huge demand for its testing. This couldn't be met due to several factors such as lack of manpower, lack of testing facilities including reagents, chemicals and testing apparatus, very high number of infections, etc. We propose a non-adaptive combinatorial pooling of samples along with algorithmic reconstruction. This has multiple advantages namely it increases the throughput of testing and at the same time conserves reagents. In the normal way of testing a single sample is tested multiple times, even if the sample is negative for COVID. Here we exploit the tendency to detect and correct for human error during the testing procedure. We have already designed metro centric construction algorithms for testing multiple samples.

Tapestry

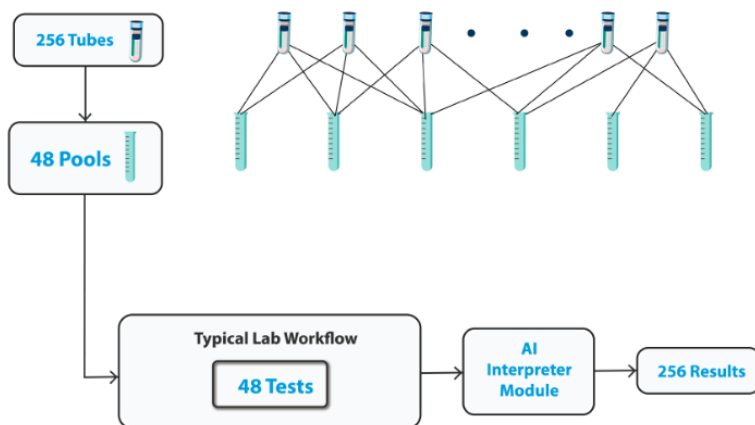


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Project summary: In this project, we apply the concept of group testing by ensuring fast processing of the testing process. Our method will also be able to save reagents and other testing resources. Here we give a brief explanation of how the project will work. Given one sample each of N different people, a simple sequential testing strategy would test each sample separately, and thus require resources that are proportional to N (in terms of units of time or other resources). However if samples are pooled together, and the pool (i.e. mixture of samples) is tested, we can quickly eliminate negatives and hope to save time and resources. The more challenging scenario is when the number of infected samples, $K > 0$ (but $K \ll N$) of the total samples, N . Furthermore K is

unknown. This project aims to use literature from group testing and compressive sensing to identify the K infected samples from N , by performing M tests where M is much less than N . This project was done in collaboration with organisations such as National Center of Biological Sciences (NCBS) and Harvard Medical School. We used inputs from them in deciding various aspects such as practical constraints on creation of the mixtures, the number of samples N in a typical pool, the number of tests M that can be performed etc. The project made a huge advancement in the frontier of innovation in healthcare.

Impact of the innovation: This research project has led to the development of a molecular search technology called Tapestry and is the key to the startup founded by Prof. Manoj Gopalkrishnan. Tapestry can also be applied to several kinds of molecular tests namely PCR, sequencing, mass spectrometry etc. Our technology can bring down the

number of tests significantly to 10% of the actual number of samples to be tested, by including a pre-processing step. The algorithm can give the final result concordant to that of individual testing.
