Development of a Cost Effective PEMS for a Greener Future

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The current approaches for emissions monitoring involve complicated sensors and data collection systems, many of which are hardware-based. These continuous monitoring systems (CEMS) come with several disadvantages including, enormous cost (e.g 0.5-2 million USD), erroneous results in periods of bad weather, the need for regular calibrations in variable ambient environments and missing data during maintenance. These costs are prohibiting industrialists in developing countries from implementing emission monitoring systems. As a result, high pollution levels are causing serious health issues (e.g. cancer clusters) in populations living around industrial areas. The concept of a predictive emission monitoring system (PEMS) is to use the operating conditions of a process, with sources of air pollutants, to construct a mathematical model that can predict online emissions by a computer program. For instance PEMS can be used on most combustion sources that fire gaseous or liquid fuels to determine emissions of components such as NOx, SO2, CO, CO2, hydrocarbons, ammonia, hydrogen sulfide etc. The advantages of PEMS reside in the capital, operation and maintenance costs which are much lower than those for a CEMS. Additional advantages include higher reliability and the ability to provide information on emissions under various weather conditions. This research aims at developing a robust and cost effective PEMS that uses an empirical model trained using improved Liquid State Machines (LSM) to predict emission concentrations based on process data. The physical plant at AUB will be used as a case study to assess the relative effectiveness of the proposed PEMS.