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Noninvasive online biomass detector system for cultivation in shake flasks

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Abstract:

A novel online sensor system for noninvasive and continuous monitoring of cell growth in shake flasks is described. The measurement principle is based on turbidity measurement by detecting 180°-scattered light and correlation to OD by nonlinear calibration models. The sensor system was integrated into a commercial shaking tablar to read out turbidity from below the shake flasks bottom. The system was evaluated with two model microorganisms, *Escherichic coli* K12 as prokaryotic and *Saccharomyces cerevisiae* as eukaryotic model. The sensor allowed an accurate monitoring of turbidity and correlation with $OD_{600} \leq 30$. The determination of online OD showed relative errors of about 7.5 % for *E. coli* K12 and 12 % for *S. cerevisiae*. This matches the errors of the laborious offline OD and thus facilitates to overcome the drawbacks of the classical method as risk of contamination and decreasing volumes through sampling. One major challenge was to ensure a defined, nonvarying measurement zone as the rotating suspension in the shake flask forms a liquid sickle which circulates round the flasks inner bottom wall. The resulting alteration of liquid height above the sensor could be compensated by integration of an acceleration sensor into the tablar to synchronize the sensor triggering.

Key-words: biomass sensor, bioprocess monitoring, optical density, scattered light, shake flask cultivation