Dynamics of Large Mining Excavators

Submitted by: RSI Technologies

Syncrude operates a large oil-sand mine in northern Alberta and owns several of the world's largest mining excavators. The boom and bucket, which look somewhat like those of a standard construction excavator, are driven by by large hydraulic cylinders operating at up to 30MPa (4350psi).

Operators of these large machines would benefit from real-time knowedge of (1) the payload in the bucket, and (2) the digging force at the bucket teeth. In order to be a viable product, this information must be related to the operator without the need to stop the motion of the machine or do anything that would hinder the production. To be useful, the information should be available to the operator with at most 1s latency and should be accurate to within 5% of the payload. Furthermore, a commercial product would be easily applied to any excavator without the need for extensive modeling.

Previous approaches to this problem have followed a traditional robotics/dynamics approach. A dynamic model of the boom and cylinders was developed. Readings from hydraulic pressure sensors and joint angle sensors were fed through the model to determine the payload. However, there are serious limitations of this approach since it is impractical to develop a detailed dynamic model of every machine to which the product would be applied.

The company is interested to know of another approach which can produce the required performance without the need to develop a more detailed dynamic model.