

Keynote speech:

Predictive control of Power Electronics Systems: Advantages and Challenges

Václav Šmíd

Abstract:

Control of power electronics converters and drives has been dominated by techniques such as PID controllers due to their simplicity and robustness. Pressure for increase in efficiency, accuracy and robustness of the power electronics applications motivates research of new control and identification techniques that have potential to improve the required properties. Predictive control is one such technique that has the potential offer these advantages. Essentially, predictive control is a way how to design a control strategy by mathematical optimization of behavior of the mathematical model of a controlled system. The key requirement is thus a good mathematical model and sufficient computational power. With increasing availability of high performance computational hardware, and significant improvement in numerical optimization, these techniques are becoming readily available even for low cost applications. Many physical phenomena in the power electronics and drives are well understood which makes the predictive control suitable for present applications. The number of success stories is growing rapidly today. However, the number of issues remain to be solved which makes the topic a promising research field. First, efficient solution for long prediction horizon is a challenge, yet it is necessary to achieve good solution in applications such as spectrum shaping. Second, mathematical models are accurate only to some degree and their accuracy is influenced by varying parameters, unmodeled dynamics and external disturbance. Suitable models for model corrections or calibrations are needed. Third, the performance index (cost function) in present techniques heavily depends on manually tuned coefficients. A methodology that would allow to reduce the need for manual tuning is required. Promising research directions will be outlined.