Most production processes require precise control but have some implicit stochastic behavior.

Process optimisation gets even more complex when dealing with multi-step processes.

Real-time calibration based on advanced artificial intelligence techniques can be used to select the best control parameters in real time also to support on-demand manufacturing.

Such models can be trained on different data sources and are compatible with virtually any hardware.

The resolution of the prediction can be tuned to the needs.

Customizable derived software can support close loop process control.

Application example: OpenMind: Customized mass production of medical guidewires

Guidewires have to be produced to strict legal and regulatory requirements - CE mark 0344 registration as class III device in Europe and an FDA 510 K (K160594) - as well as to strict technical specifications (diameter and stiffness, the latter which must vary precisely in different sections of the guidewire). Such medical devices require precise micron level control, are multimaterials (high strength core composite of glass fibers and resin, protected by a high-strength aramid fiber mantle covered with PTFE) and made using 4 interlinked sequential processes (pultrusion, pullwinding, laser ablation and coating). Furthermore, each patient and surgical intervention has its own characteristics and requirements. Currently, their production requires specialist and time-consuming calibration procedures for the different hardware processes.
The machine learning tool can support the quick selection of valid parameter combinations (point cloud) which is challenging when made empirically in such a tight processing window.

The next figures show an example of one of the inputs and outputs of the coating process model.

Distributions of values generated by Monte Carlo calibration

Sequence of outputs of coating process data model in response to Monte Carlo generated inputs. From left to right, successive closest values are found to the line of the target value (933), until a value within set specs is reached.


Conclusion

By automating a time-consuming artisanal calibration process, automatic parameter selection systems can be applied to most processes for ramp up, optimization, reducing scrap and reducing re-calibration down time to make it possible to achieve customized mass-production.