Popular Science Summary

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Signal-Aware Predistortion Configuration Using Unsupervised Learning for 5G–Advanced/6G Radios

Can mobile networks become more energy efficient without sacrificing quality? This project shows how combining machine learning with traditional methods can optimize radio systems—while revealing an important trade-off.

Modern mobile networks are under constant pressure to deliver more data, faster and more efficiently. At the heart of this challenge is the radio transmitter's power amplifier, which boosts signals before transmission. However, these amplifiers are imperfect—they distort the signal and can cause interference with nearby channels.

To address this, engineers use a technique called digital predistortion (DPD). It works by "pre-correcting" the signal before it enters the amplifier, so that the final transmitted signal remains clean and accurate. The challenge is that configuring DPD is both time-consuming and resource-intensive.

This thesis explores whether machine learning can make this process more efficient. Using a method that automatically groups similar signal conditions, the system can determine how many DPD configurations are needed. The results show that this approach reduces resource usage—requiring less computation and memory—while still maintaining signal quality.

However, there is a catch: the method increases the time required to integrate and configure the system in hardware. In industrial settings, where time-to-deployment is critical, this becomes a significant drawback. The most promising solution turned out to be a hybrid approach, combining machine learning with traditional optimization techniques. This achieved both low resource usage and reasonable integration time.

The key takeaway is that there is a clear trade-off: improving efficiency in one area can make another more challenging. The optimal solution therefore depends on system priorities. At the same time, the results highlight how combining modern machine learning with established engineering methods can pave the way for smarter and more efficient future communication systems