Efficient Multidimensional Polynomial Filtering for Nonlinear Digital Predistortion

Matthew Herman, Benjamin Miller, Joel Goodman

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**Motivation**

- The objective of Nonlinear Digital Predistortion (NDP) is to digitally alter the input to the PA to compensate for the distortions imparted by the device.
  - NDP is capable improving power efficiency while reducing ACI and BER.
- Computationally efficient memoryless NDP techniques are not sufficient for linearizing wideband PAs that impart significant memory effects.
- Not feasible to use a computationally complex polynomial predistorter to model/invert state dependent nonlinearities.
  - Most previous polynomial approaches consider 1D subkernels as building blocks for the full PD.
  - Multidimensional filters more easily address asymmetric and aliasing NL.

**OBJECTIVE:** Use small multidimensional filters to build a computationally efficient nonlinear digital predistorter.
Methods

- Divide the full coefficient space into cube coefficient subspaces (CCS), i.e., small hypercubes/parallelepipeds (“diagonal” CCS-D) of arbitrary dimension.
- Model the inverse NL by greedily selecting only the CCS components that have the greatest impact on performance.
- CCS allows efficient adaptation in multiple dimensions starting with the first nonlinear component selected.
- CCS has an efficient hardware implementation.
Results

Measured Results using Q-Band Solid State PA:

Computational Complexity:

<table>
<thead>
<tr>
<th>Architecture</th>
<th>Complex Mult. Per Sample</th>
<th>Complex Add. Per Sample</th>
<th>Op’ns Per Second (GOPS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generalized Memory Polynomial</td>
<td>156</td>
<td>144</td>
<td>147</td>
</tr>
<tr>
<td>2-D CCS/CCS-D</td>
<td>76</td>
<td>32</td>
<td>62</td>
</tr>
</tbody>
</table>

CCS NDP improves ACI by ~20 dB.

CCS reduces ACI by ~7 dB more than the state-of-the-art GMP with less than half as many operations per second.