Security Level:

在先进研究中利用MATLAB和Simulink平台加速理论到工程实践

MathWorks CHINA MATLAB TOUR 2016

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演讲人介绍

- 罗龙，电子科技大学，通信与信息系统博士学位
- 华为技术有限公司算法架构设计部部长，主要从事通信系统算法研究、芯片架构设计等工作。
- 先后从事过无线WCDMA、LTE/5G、光通信、微波、铜线及SDN/IP等领域算法及架构设计

目录

- 基本情况介绍
- 面临的挑战和未来策略
- MATLAB和Simulink应用效果
- 经验总结

目录

华为公司介绍

170+
国家

228
世界500强排名

17.6万
员工

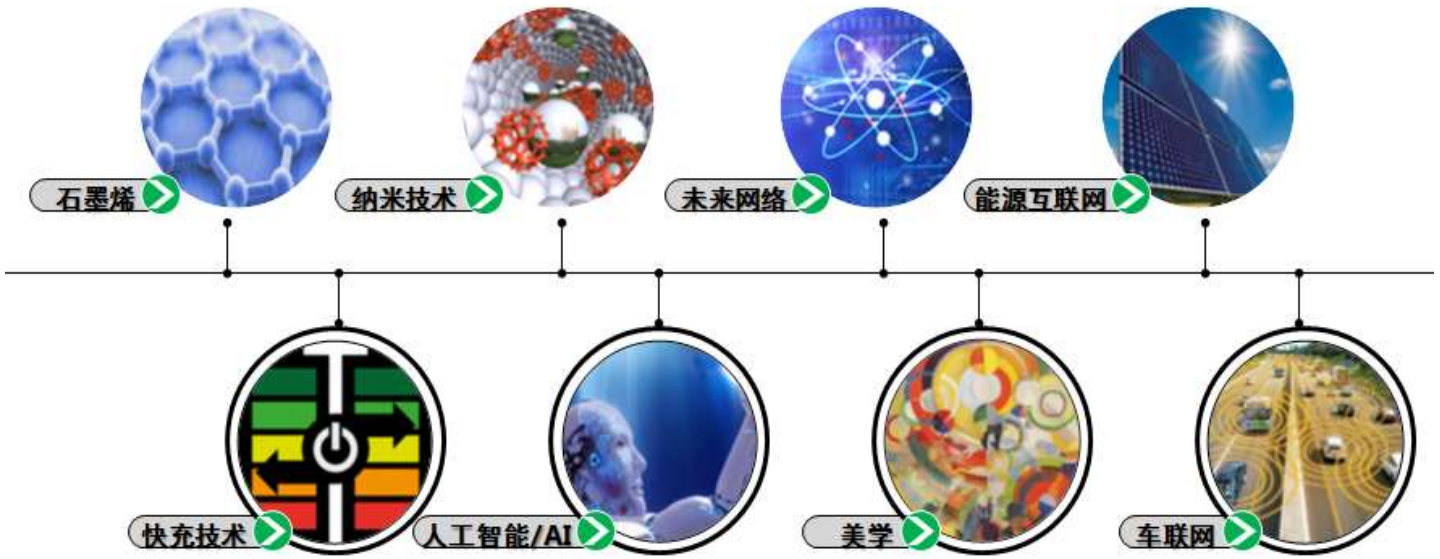
79,000
研发员工

36
联合创新中心

16
研发中心

持续研发投入，参与重塑未来的创新

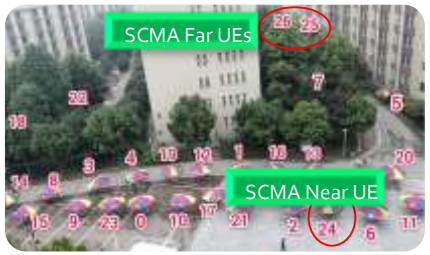
15年研发投入
59607

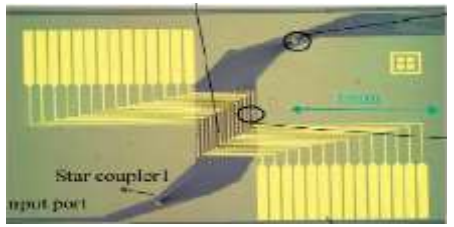


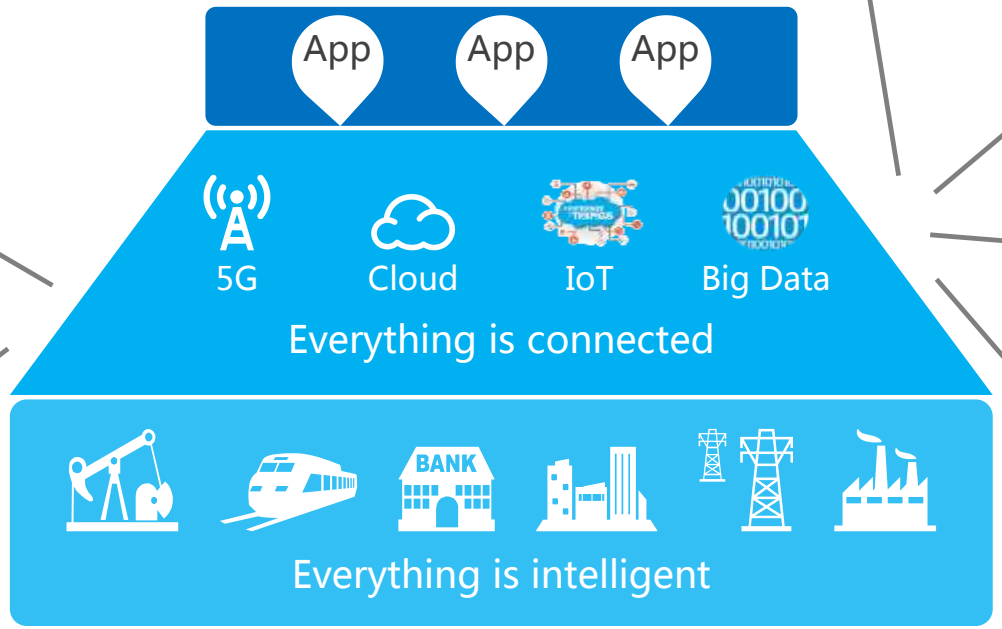
目录

通信网络技术持续创新

- 随着业务的发展，未来网络及终端面临巨大的创新机会
- 高效的系统设计、快速样机验证选型、利用业界成果是关键

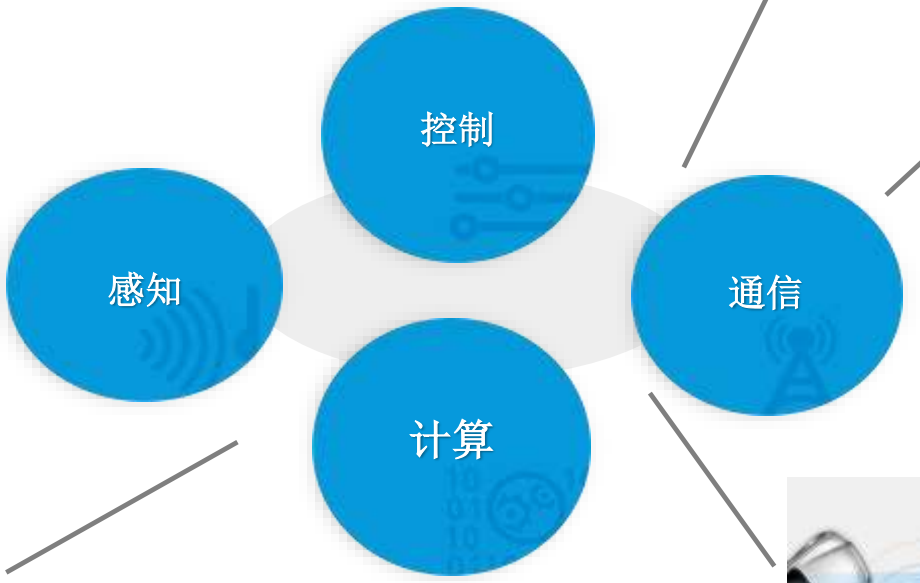


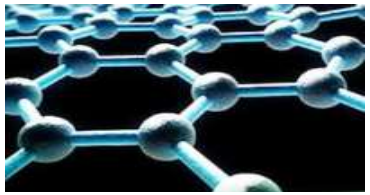




开拓重塑未来新领域

- 物联网、医疗、AI、汽车、能源、材料等新领域充满机会
- 机器学习、数学建模、理论突破、快速系统验证选型是关键





持续创新所面临挑战

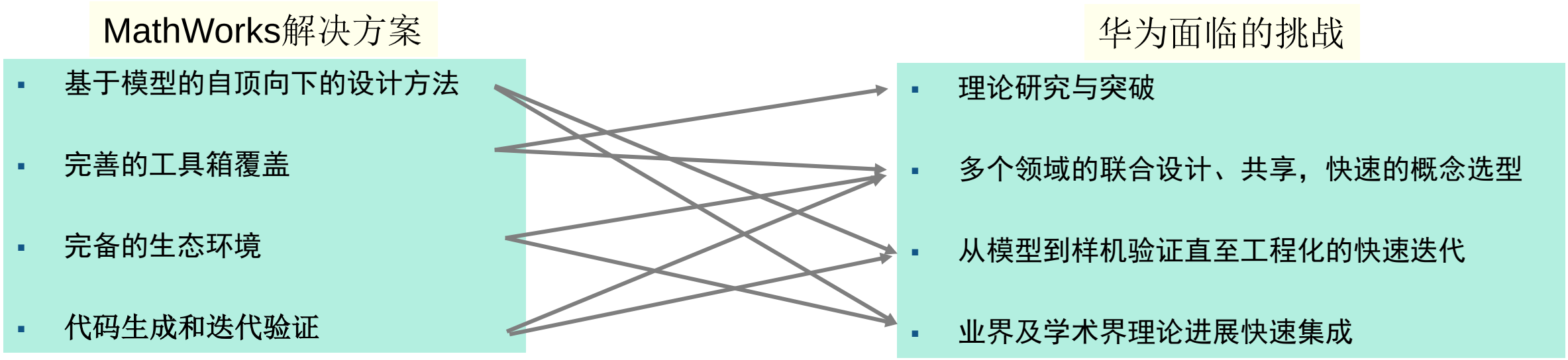
依托理论突破，加速创新idea工程化、提升产品化效率

更好满足客户需要

目录

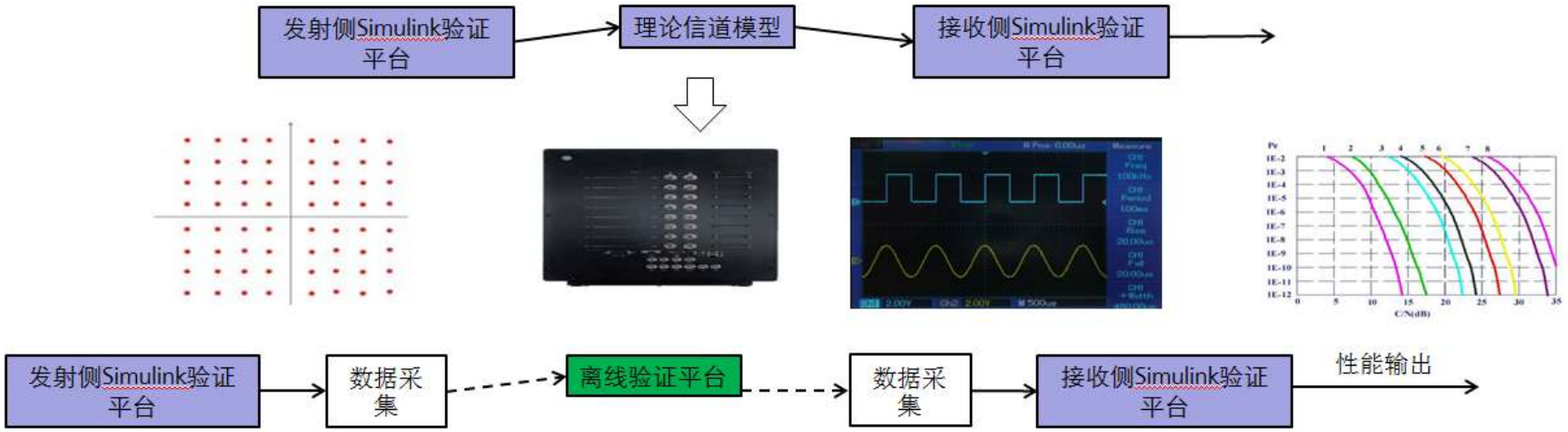
MathWorks解决方案

- **MathWorks解决方案很好的帮助了华为应对所面临的挑战**
- **在无线领域、光传输领域、终端、及其他新型创新领域发挥了很大作用**



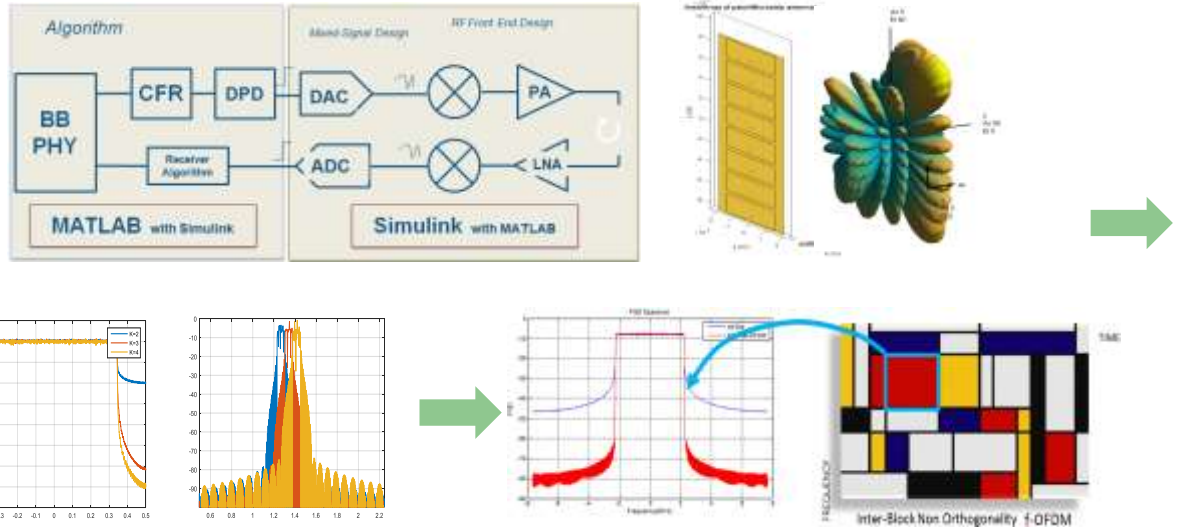
Simulink辅助超高速算法仿真与离线验证

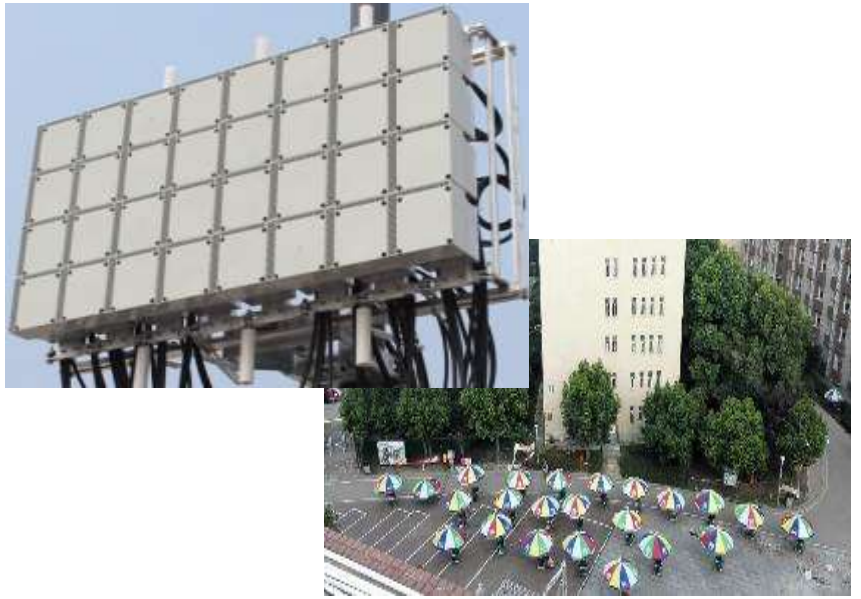
- 搭建发射/接收仿真链路，发送侧数据通过超高速/带宽器件，仪器快速提取/保存离线数据
- 离线数据导入接收侧仿真链路，接收仿真链路对数据进行解调、仿真性能分析



下一代无线新技术设计与验证

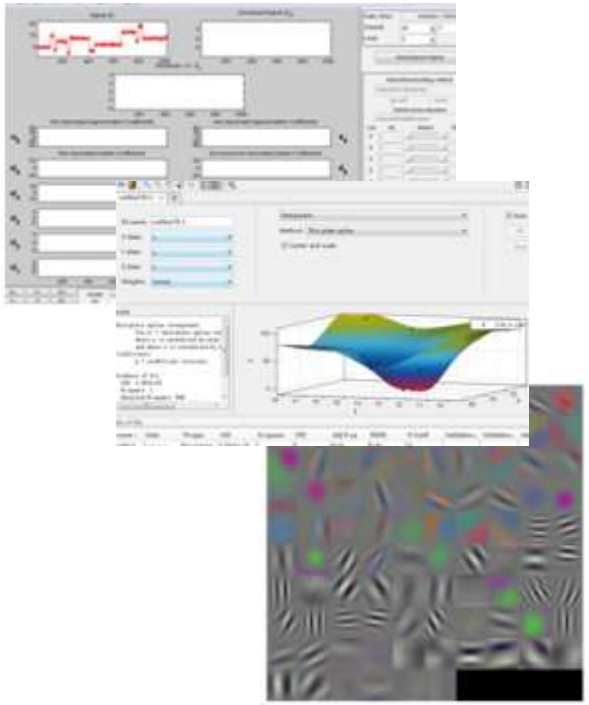
- 搭建空口链路、导入参数、模型，算法仿真分析
- 生成硬件代码导入硬件平台验证
- 外场测试及数据报表生成和分析

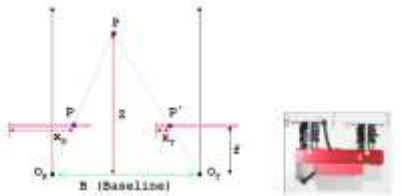




图像处理及识别

- 利用工具箱实现图像补偿、景深计算及计算机图像识别





With the stereo rig in standard form and by considering similar triangles (PO_lO_r and Ppp'):

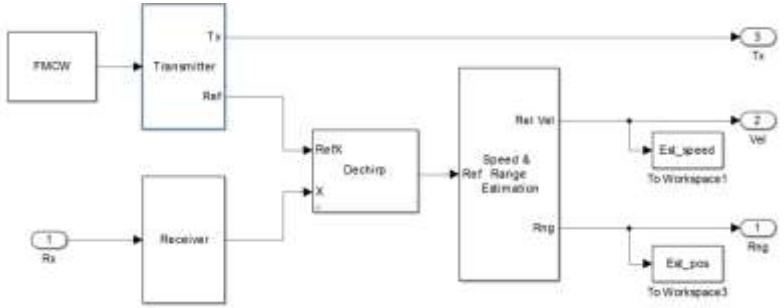
$$\frac{b}{Z}=\frac{(b+x_r)-x_l}{Z-f} \rightarrow Z=\frac{b\cdot f}{x_l-x_r}=\frac{b\cdot f}{d}$$

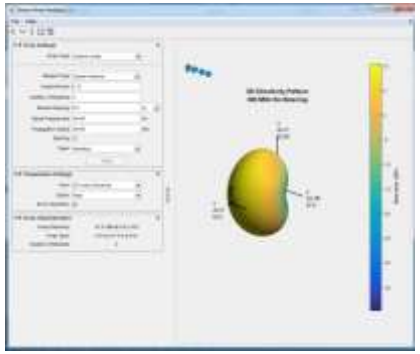
x_l-x_r is the disparity

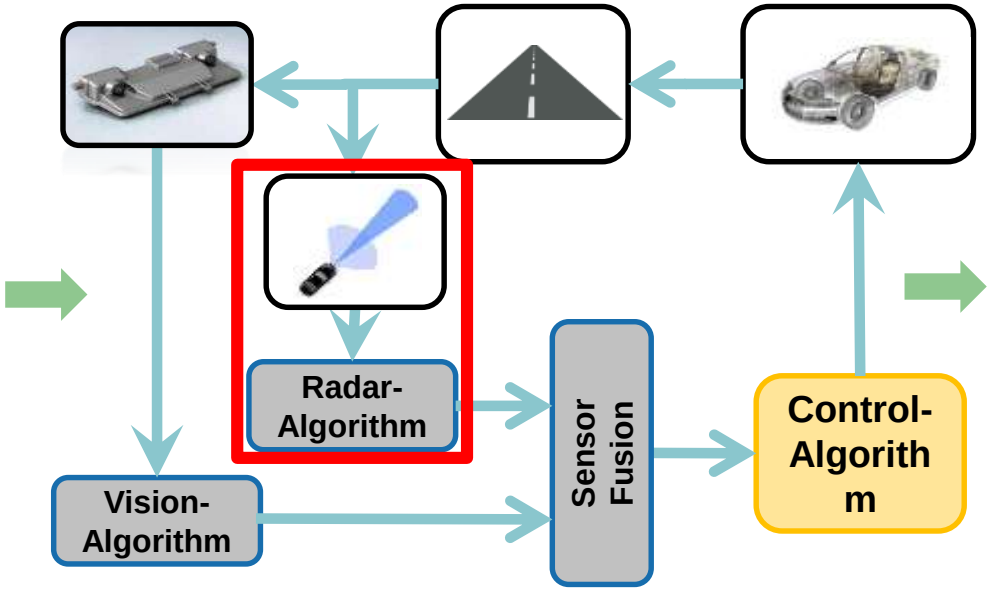
Scene: a group of young men playing a game of soccer

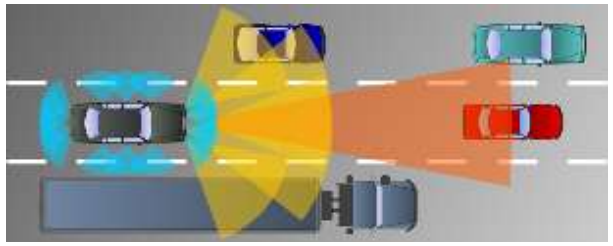
自动驾驶

- 通过雷达建模，实现雷达辅助的EAI（Educated Application Intelligence）自动驾驶建模



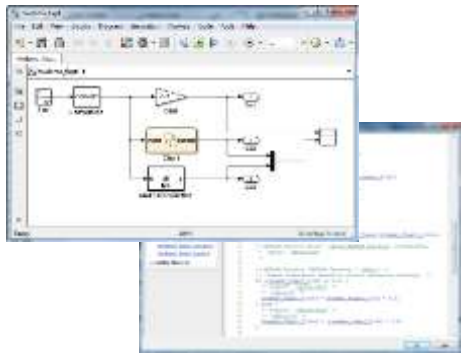






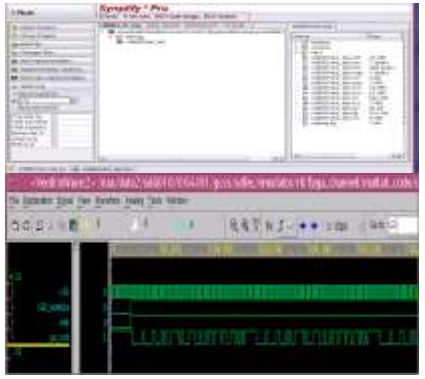
高速FEC代码生成支持快速验证

- 通过代码生成，与手工相比可以提高50%效率
- 资源占用略高于手工编写，时序与手工相当，满足算法验证要求



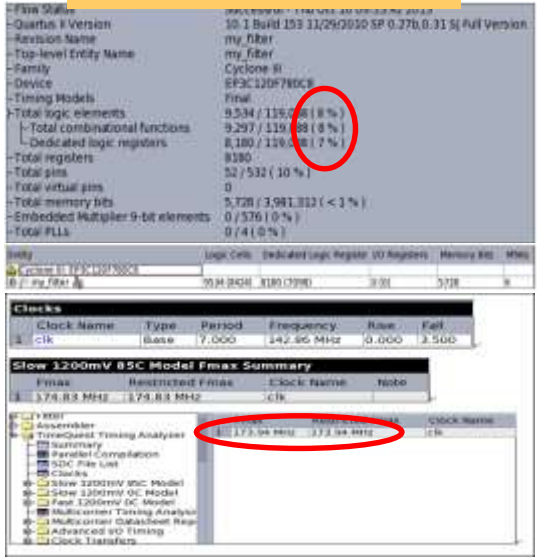
HDL coder代码生成

综合/仿真验证



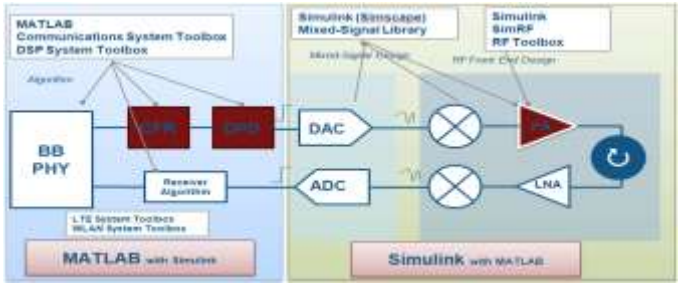
FPGA加载 上板验证

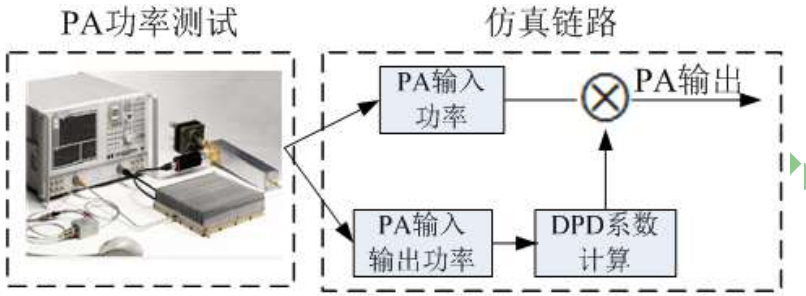
资源占用和时序分析

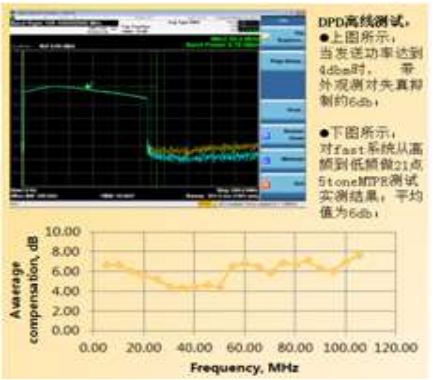


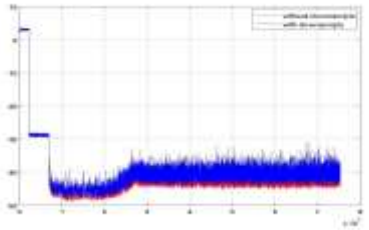
毫米波DPD算法设计

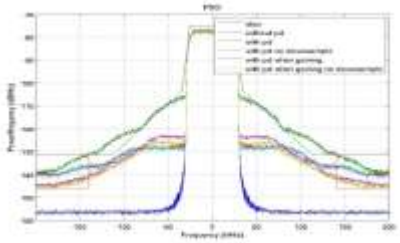
- 根据高频功率放大器类型，建立功放非线性模型
- 通过Simulink进行非线性补偿算法验证

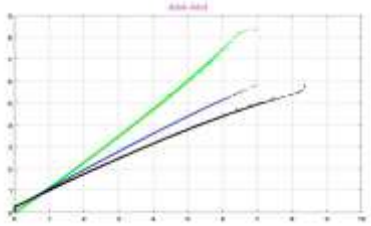






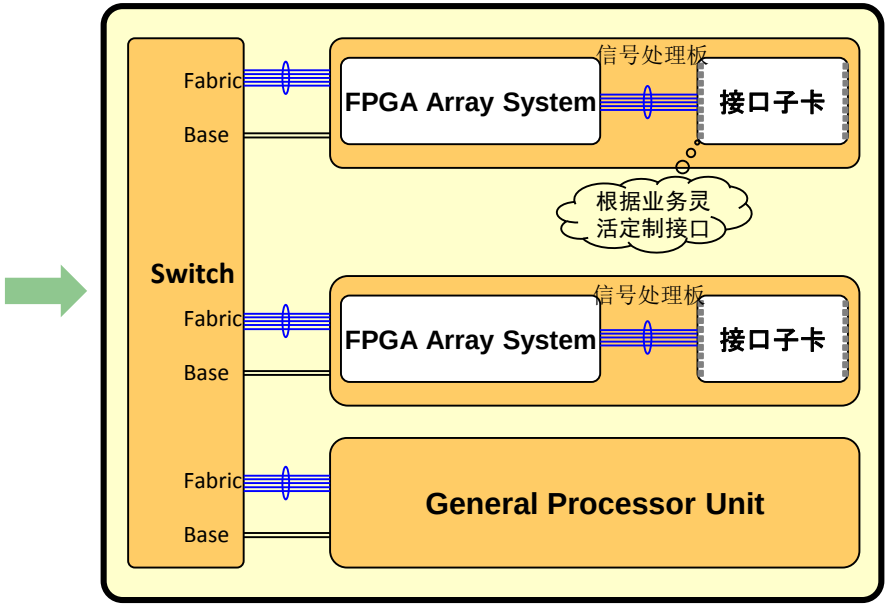


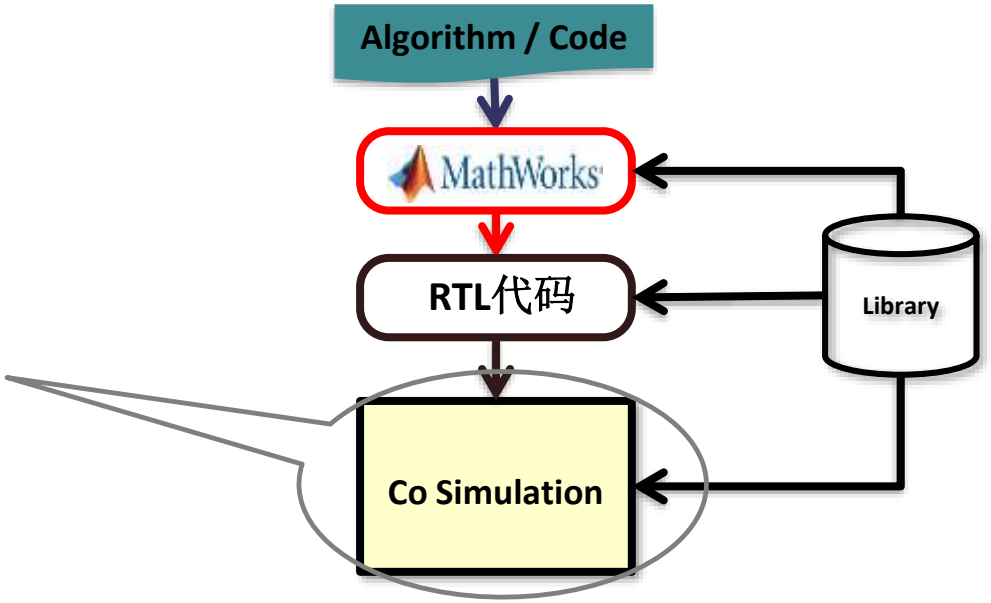




与定制硬件平台结合

- 定制硬件加速算法平台硬件在环系统
- 利用代码生成加速算法验证及选型



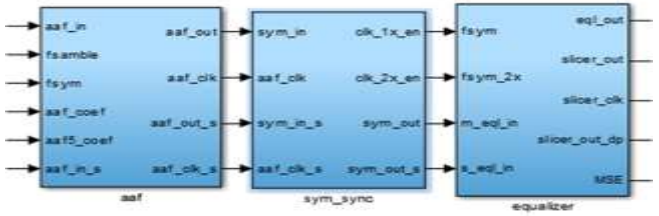


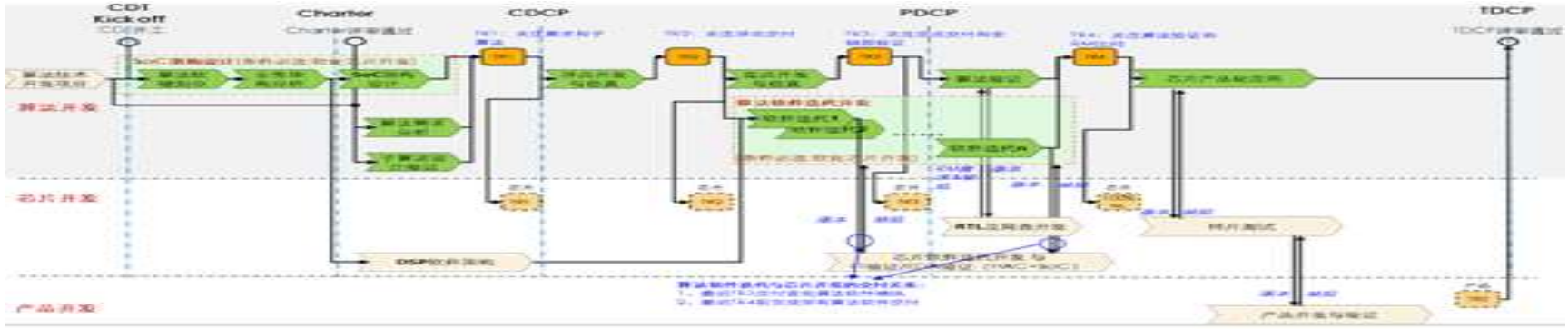
模型驱动的系统设计方法

$$R = HWS + N$$

$$W = SVD\left\{\begin{pmatrix} h_{11} & h_{12} & h_{13} & h_{14} \\ h_{21} & h_{22} & h_{23} & h_{24} \\ h_{31} & h_{32} & h_{33} & h_{34} \\ h_{41} & h_{42} & h_{43} & h_{44} \end{pmatrix}\right\} S = \begin{pmatrix} s_1 & -s_2^* & -s_3^* & s_4 \\ s_2 & s_1^* & -s_4^* & -s_3 \\ s_3 & -s_4^* & s_1^* & -s_2 \\ s_4 & s_3^* & s_2^* & s_1 \end{pmatrix}$$

$$\begin{cases} \hat{S} = GR + \hat{N} \\ G_{MMSE} = \left[\mathbf{H}^H\mathbf{H} + \sigma^2\mathbf{I}\right]^{-1}\mathbf{H}^H \\ \quad = \mathbf{H}^H\left[\mathbf{H}\mathbf{H}^H + \sigma^2\mathbf{I}\right]^{-1} \\ \quad = \mathbf{H}^H\mathbf{R}_{yy}^{-1} \end{cases}$$





- 产品需求导入
- 建模及数学分析

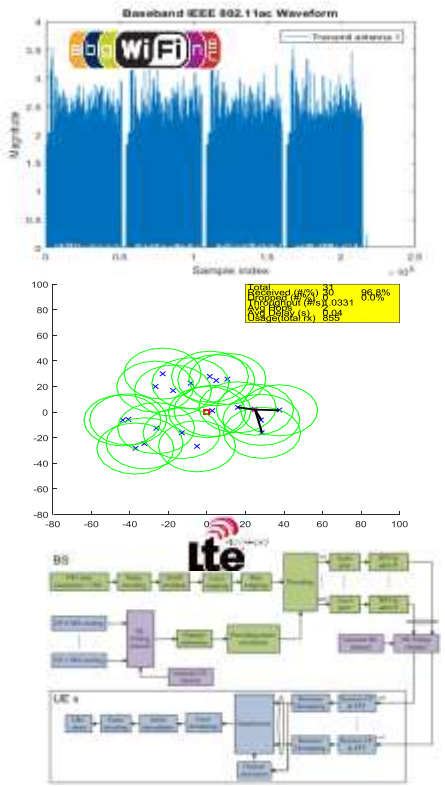
- 搭建系统仿真链路
- 算法选型与优化

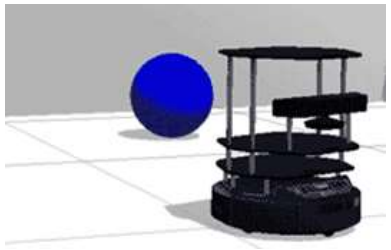
- RTL代码生成、调测
- 样机系统验证回归测试

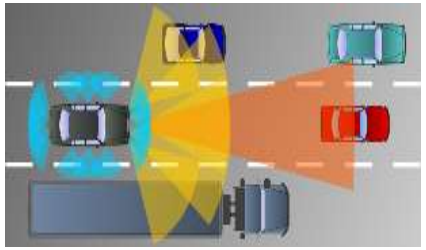
- 支持快速样片及测试

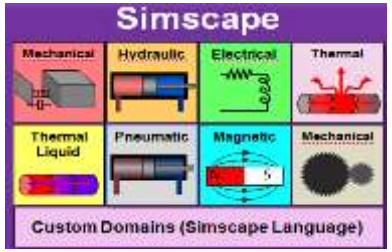
完善的理论/工程应用工具箱

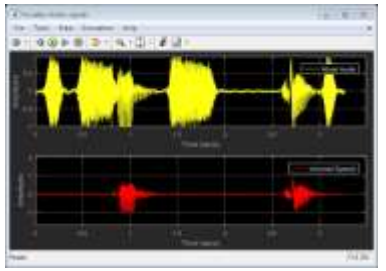
- 支持最新算法理论快速应用
- 及时为最新的创新方向提供帮助
- 完整的工程应用工具箱覆盖
- 为终端、网络、自动驾驶、AI、5G等方面提供了有力的支持

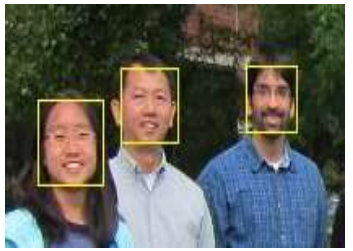


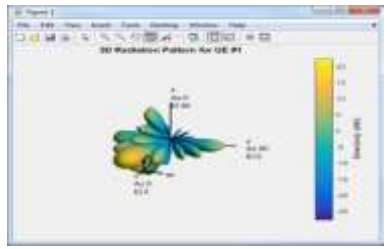






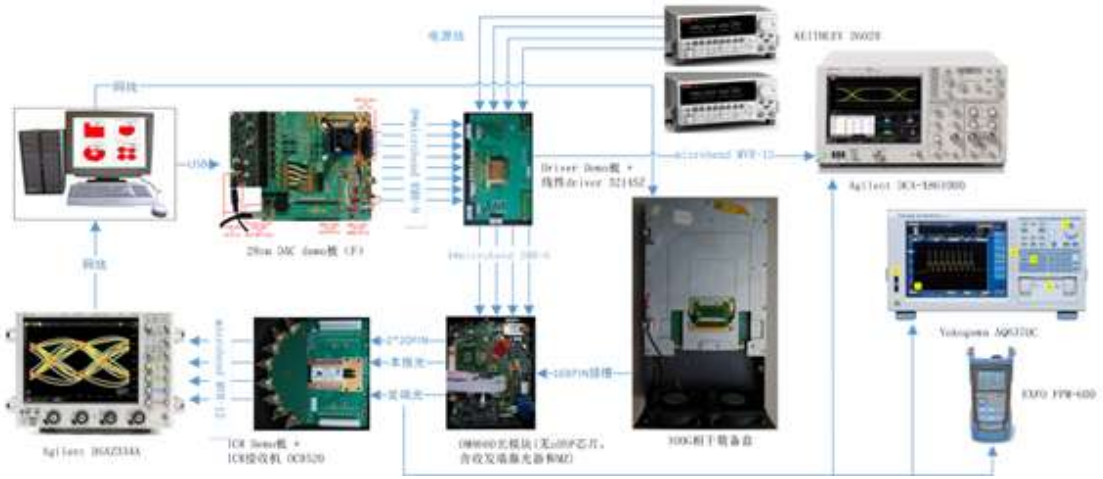


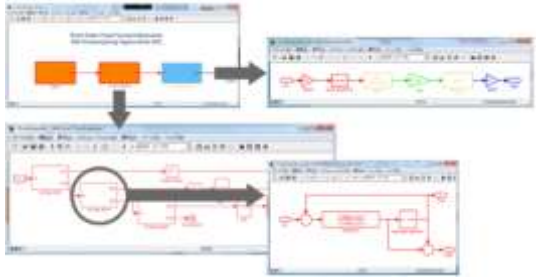


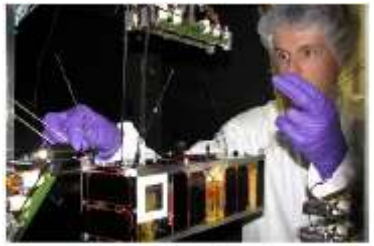


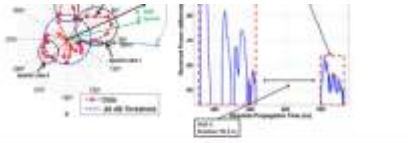
完备的生态环境

- 与业界成熟开发设计工具、仪器仪表无缝结合，快速实现系统设计到工程化实现
- 成为学术界、工业界共享的平台，构建关键算法、模块库，加速理论到实现转化







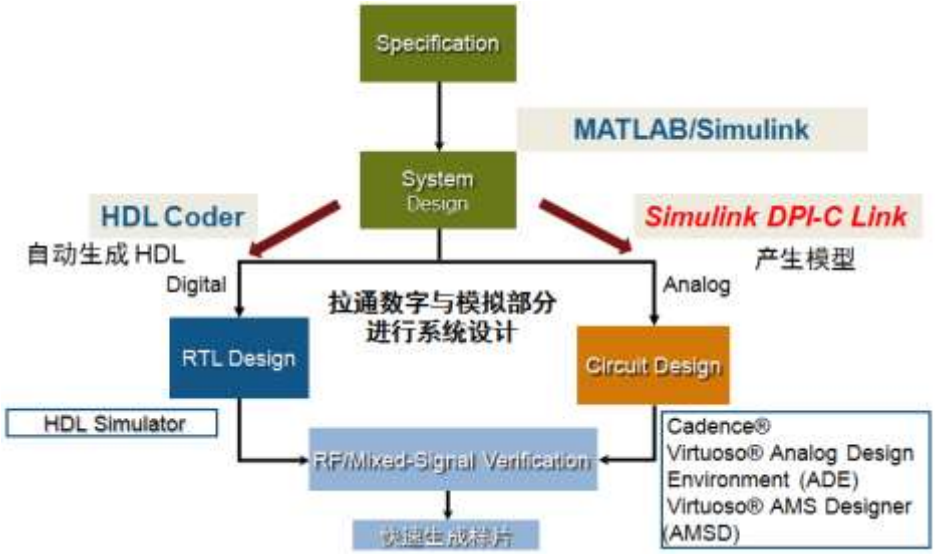


NYU WIRELESS 5G Millimeter Wave Statistical Channel Model Suitable for 3GPP and Academic/Industrial Simulations

目录

经验总结

- **模型到工程化有较完善的工具链**
  - 强化系统设计、缩短时间：DPD
  - 代码生成节省迭代次数：高速FEC设计
  - 需要与研发流程逐步融合
- **较完备的工具箱有力支持创新需要**
  - 快速理论研究与突破：深度学习
  - 多领域联合设计/共享/快速概念选型：自动驾驶
- **对业界的工具有较好的支撑**
  - 业界及学术界理论进展快速集成
  - 研究成果迅速产业化



下一步展望

- 丰富并促进资源库建设、加强最新理论/热点技术支持
- 满足目标FPGA/DSP要求的高效率代码生成
- 进一步提升超高速信号处理算法仿真效率

Thank you

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