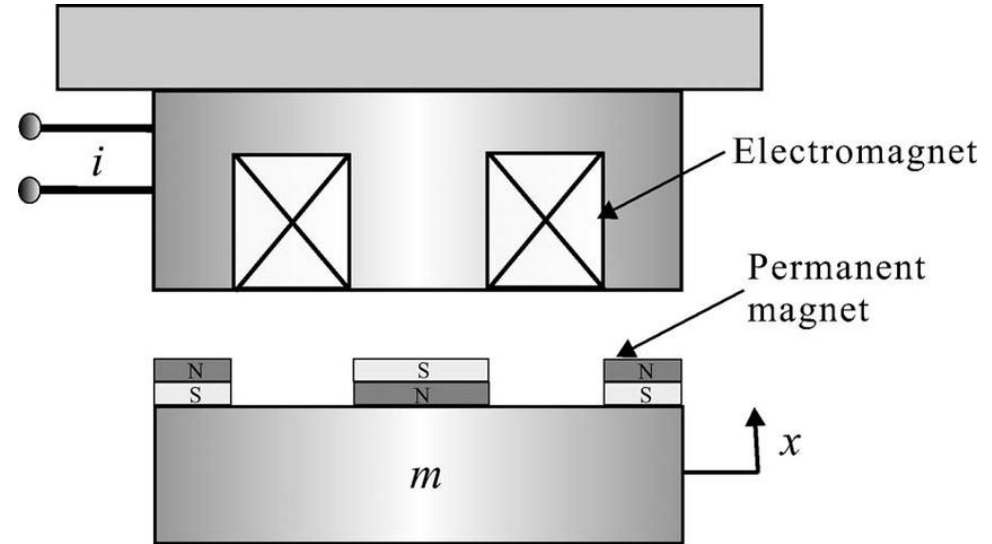
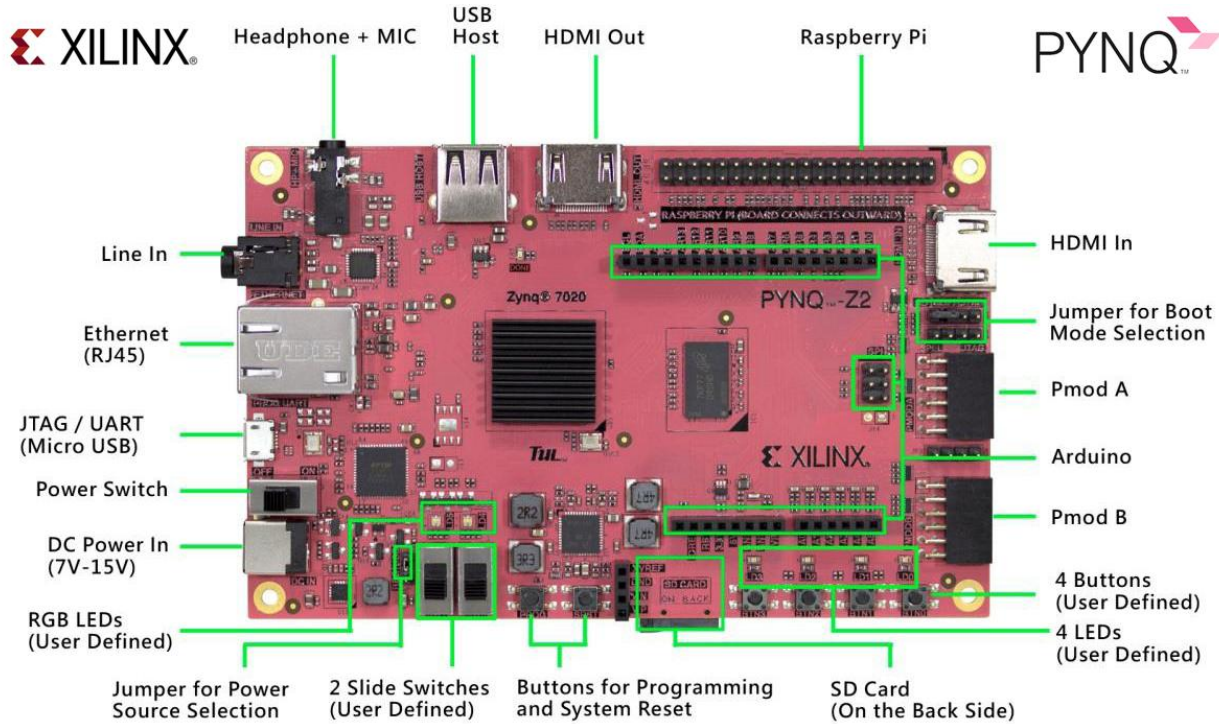


ZERO-POWER MAGNETIC LEVITATION

- **Classically a control loop sensing position and modulating a solenoid**
 - High Power Use
- **Can use PM to do the lifting**
 - Control loop just stabilizes the position to balance gravity
- **Interesting Control Problem**
 - Lots of commercial uses
 - Position feedback and coil power feedback
 - H-Bridge Digital PWM Drive

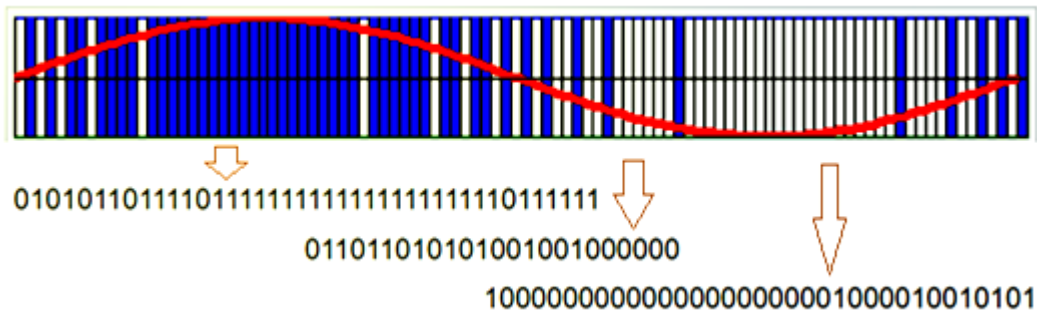


PYNQ Development Board



- ZYNQ XC7Z020-SOC
- Dual-Core ARM A9
- 2x PMOD GPIO
- Ethernet Jupiter Notebook Service
- Boots Linux OS
 - Python Development Code
 - 400MB/s logging to network
 - Software loadable FPGA firmware

Sigma-Delta Computation Modality



- Data values passed as binary bit-streams
- Pulse Density Encoding
- No Multipliers
- Low Latency (oversampling)
- Tiny Footprint/Power
- Any LT Filter (and many non-linear)
- Can fit 8th-order 65db filter in \$2.00 FPGA (2mA @20MHz)

GOALS

- **Create Magnet/Solenoid Platform**
- **Pynq based controller Development**
- **ICE-40 low power**
 - Minimal power
- **1-2 Controls**
 - Controller Design
 - SD Implementation
- **1-2 CE/EE**
 - Demo Platform
 - Pot Core?
 - Position Feedback
 - H-Bridge Drive