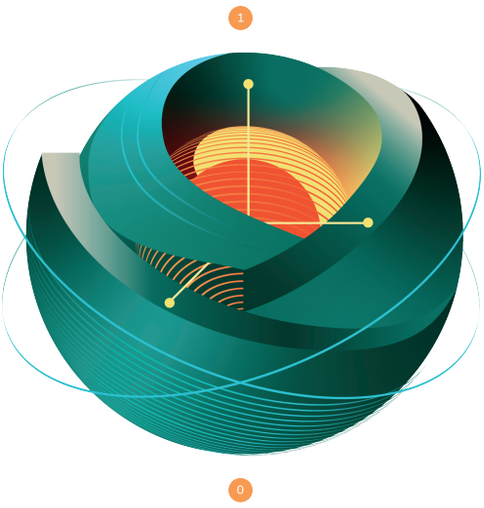
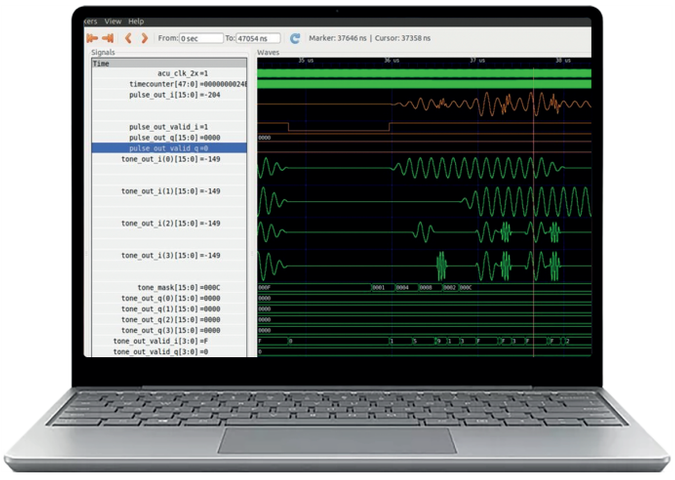
Deltaflow.Control

A scalable and customisable control system for generating high accuracy, high speed pulse sequences for qubit control





Setting up a qubit control system and configuring experiments on a day-to-day basis should be a quick and simple process, leaving you more time to focus on your research. That's why we've built Deltaflow.Control.

Deltaflow.Control makes it easy to write control code using pure Python, meaning no need to learn product or platform specific languages, and making the transition from your existing control code easy. World-class technical support from our team of quantum control engineers means a stress free path to achieving your research goals.

Deltaflow.Control is currently available for trapped ion and cold atom qubit types.

Fully programmable

Easy integration and setup

Professional-level debugging and clock cycle accurate simulation

Low-latency decentralised architecture

World class support

Specifications

All figures apply to Deltaflow.Control running on AMD Xilinx ZCU111/ZCU216 RFSoC devices

DAC sampling rate for ZCU111 RFSoc	14-bit 4 gigasamples/s
DAC sampling rate for ZCU216* RFSoC	14-bit 8 gigasamples/s
Digital Inputs/Outputs	4/12
Pulse timing resolution	Down to 1 ns
Frequency range	20 MHz - 400 MHz as default, and up to 6 GHz*
Multi-tone signal bandwidth*	200 MHz
Multi-tone generation*	4-8 tones per channel

** in development*

Deltaflow.Control Library (DCL)

The Deltaflow.Control library includes a set of Python APIs that allow you to write familiar Python code to configure and control your system. There is also an extensive collection of tutorials and examples to get you up and running quickly, including:

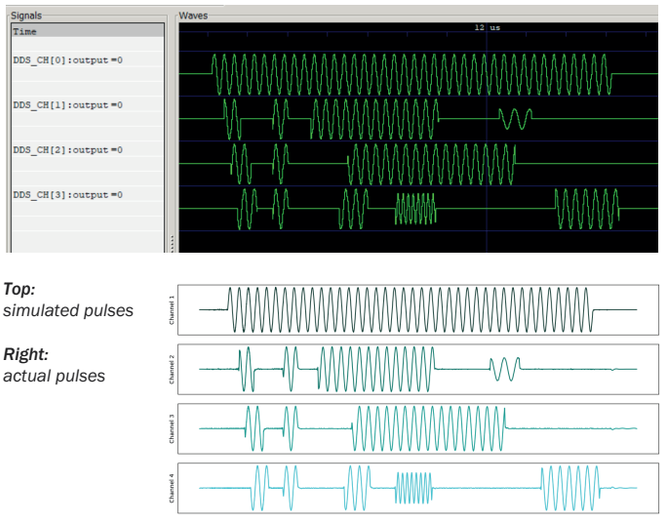
- Direct digital synthesis (DDS) pulse generation
- Digital I/O control
- Single tone frequency generation
- Laser Doppler cooling, spin echo, Ramsey interferometry, Rabi oscillation

```
for idx in range(4):
      batch.advance_cursor(20)
      batch.add(dds_ch[idx].gen_pulse_cmd(pulses[idx]))

batch.advance_cursor(max_pulse_len_ns - 80)

batch.add(dig_out.set_digital_output_cmd(0, OutputState.HIGH))
```

Customisation

Deltaflow.Control is fully customisable to your requirements so you can build a control system that's tailored to your research goals, enabling you to go further, faster.

- Full control over type and number of inputs and outputs
- Access to a growing set of hardware accelerators



Top:
simulated pulses

Right:
actual pulses

Visualisation and Simulation

Our visualisation tool allows you to inspect all control pulses simultaneously to verify the correct configuration of your control system before you start experimenting. Hardware-accurate software simulation gives you deep insight into the behaviour of every element of the system and 100% confidence in the output. The result - fewer iterations to perfect your experiments.

- Hardware clock-cycle accurate simulation at the hardware description language (HDL) level
- Automatic integration with the powerful GTKWave visualisation tool
- Simple switching between SW simulation and execution on connected HW with a one line code change

Deterministic Stack

Deltaflow.Control features a highly verified, deterministic, zero-defect control stack, with advanced traceability that users can trust to generate control pulses accurately.

- Complete phase control and cross-channel synchronisation
- Verification of all components at HDL level

Support

With our dedicated team of Quantum Control Engineers, you can count on our support throughout the setup, installation and development of your control system.

- Combined 30 years' experience in ion and atomic qubit control research
- Hands-on support through every step of setup and installation
- Ongoing support from the team as you continue your research journey

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Find out more: https://www.riverlane.com/products/deltaflow-control