RetargetCircuit

```
SetDirectory @ NotebookDirectory[];
Import["../Link/QuESTlink.m"];
```

Doc

```
? RetargetCircuit
```

Symbol

RetargetCircuit[circuit, rules] returns the given circuit but with its target and control qubits modified as per the given rules. The rules can be anything accepted by ReplaceAll.

For instance RetargetCircuit[..., {0->1, 1->0}] swaps the first and second qubits, and RetargetCircuit[..., q_ -> q + 10] shifts every qubit up by 10.

This function modifies only the qubits in the circuit, carefully avoiding modifying gate arguments and other data, so it is a safe alternative to simply evaluating (circuit /. rules).

Custom user gates are supported provided they adhere to the standard QuESTlink subscript format.

Tests

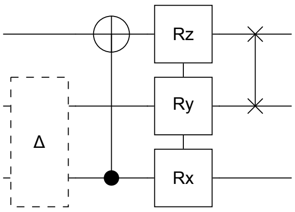
```
? QuEST`Gate`*
```

```
QuEST`Gate`

Damp      H           Matr    Ry      U
Deph      Id          P       Rz      UNonNorm
Depol     Kraus       Ph      S       X
Fac       KrausNonTP  R       SWAP    Y
G         M           Rx      T       Z
```

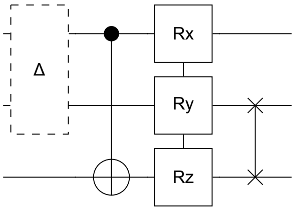
Arbitrary rules

in = Circuit[$\text{Depol}_{0,1}$[x] C_0[X_2] R[x, X_0 Y_1 Z_2] $\text{SWAP}_{1,2}$];
DrawCircuit[in]



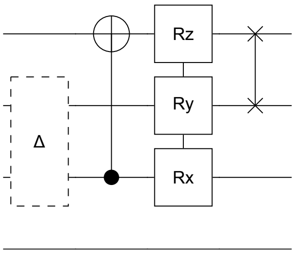
out = RetargetCircuit[in, {0 → 2, 2 → 0}]
DrawCircuit[out]

{$\text{Depol}_{2,1}$[x], C_2[X_0], R[x, X_2 Y_1 Z_0], $\text{SWAP}_{1,0}$}



out = RetargetCircuit[in, q_ → q + 1]
DrawCircuit[out]

{$\text{Depol}_{1,2}$[x], C_1[X_3], R[x, X_1 Y_2 Z_3], $\text{SWAP}_{2,3}$}



Gate support, and no modification of arguments

RetargetCircuit[Circuit[
Damp_0[0] $\text{Deph}_{0,1}$[0] $\text{Depol}_{0,1}$[0] Fac[0] × G[0] H_0 $\text{Id}_{0,1}$ ×
$\text{Kraus}_{0,1}$[0, 0] $\text{KrausNonTP}_{0,1}$[0, 1] $M_{0,1}$ $\text{Matr}_{0,1}$[0] ×
$P_{0,1}$[0, 1] $\text{Ph}_{0,1}$[0] R[0, X_0] × R[0, X_0 Y_0 Z_1] $\text{Rx}_{0,1}$[0] ×
$\text{Ry}_{0,1}$[0] $\text{Rz}_{0,1}$[0] S_0 $\text{SWAP}_{0,1}$ T_0 $U_{0,1}$[0, 1] ×
$\text{UNonNorm}_{0,1}$[0, 1] X_0 Y_0 Z_0],
0 → a]

{Damp_a[0], $\text{Deph}_{a,1}$[0], $\text{Depol}_{a,1}$[0], Fac[0], G[0], H_a, $\text{Id}_{a,1}$, $\text{Kraus}_{a,1}$[0, 0],
$\text{KrausNonTP}_{a,1}$[0, 1], $M_{a,1}$, $\text{Matr}_{a,1}$[0], $P_{a,1}$[0, 1], $\text{Ph}_{a,1}$[0], R[0, X_a], R[0, X_a Y_a Z_1],
$\text{Rx}_{a,1}$[0], $\text{Ry}_{a,1}$[0], $\text{Rz}_{a,1}$[0], S_a, $\text{SWAP}_{a,1}$, T_a, $U_{a,1}$[0, 1], $\text{UNonNorm}_{a,1}$[0, 1], X_a, Y_a, Z_a}

Controls

RetargetCircuit[$C_{0,1,2}$[X_3], {0 → a, 3 → b}]

{$C_{a,1,2}$[X_b]}

Qubit configurations (sequence vs list)

RetargetCircuit[{X_0, $X_{0,1}$, $X_{\{0\}}$, $X_{\{0,1\}}$}, 0 → a]

{X_a, $X_{a,1}$, $X_{\{a\}}$, $X_{\{a,1\}}$}

RetargetCircuit[{Ph_0[0], $Ph_{0,1}$[0], $Ph_{\{0\}}$[0], $Ph_{\{0,1\}}$[0]}, 0 → a]

{Ph_a[0], $Ph_{a,1}$[0], $Ph_{\{a\}}$[0], $Ph_{\{a,1\}}$[0]}

RetargetCircuit[{R[0, X_0], R[0, X_0 Y_0 Z_1]} , 0 → a]

{R[0, X_a], R[0, X_a Y_a Z_1]}

RetargetCircuit[{C_0@R[0, X_0], $C_{\{0,1\}}$@R[0, X_0 Y_0 Z_1]} , 0 → a]

{C_a[R[0, X_a]], $C_{\{a,1\}}$[R[0, X_a Y_a Z_1]]}

Non-integer qubits

RetargetCircuit[{Rx_a[a]}, a → b]

{Rx_b[a]}

Errors

RetargetCircuit[{X_0, Y_1}, invalid]

••• ReplaceAll: {invalid} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

$Failed

RetargetCircuit[{Anon}, 0 → 1]

••• RetargetCircuit: Could not identify qubits in unrecognised gate: Anon

$Failed

RetargetCircuit[hi]

••• RetargetCircuit: Invalid arguments. See ?RetargetCircuit

$Failed

RetargetCircuit[hello, there, friend]

••• RetargetCircuit: Invalid arguments. See ?RetargetCircuit

$Failed