Initial Characterization of the RFQ and Water System

2016-01-12

Auralee Edelen
auralee.morin@colostate.edu

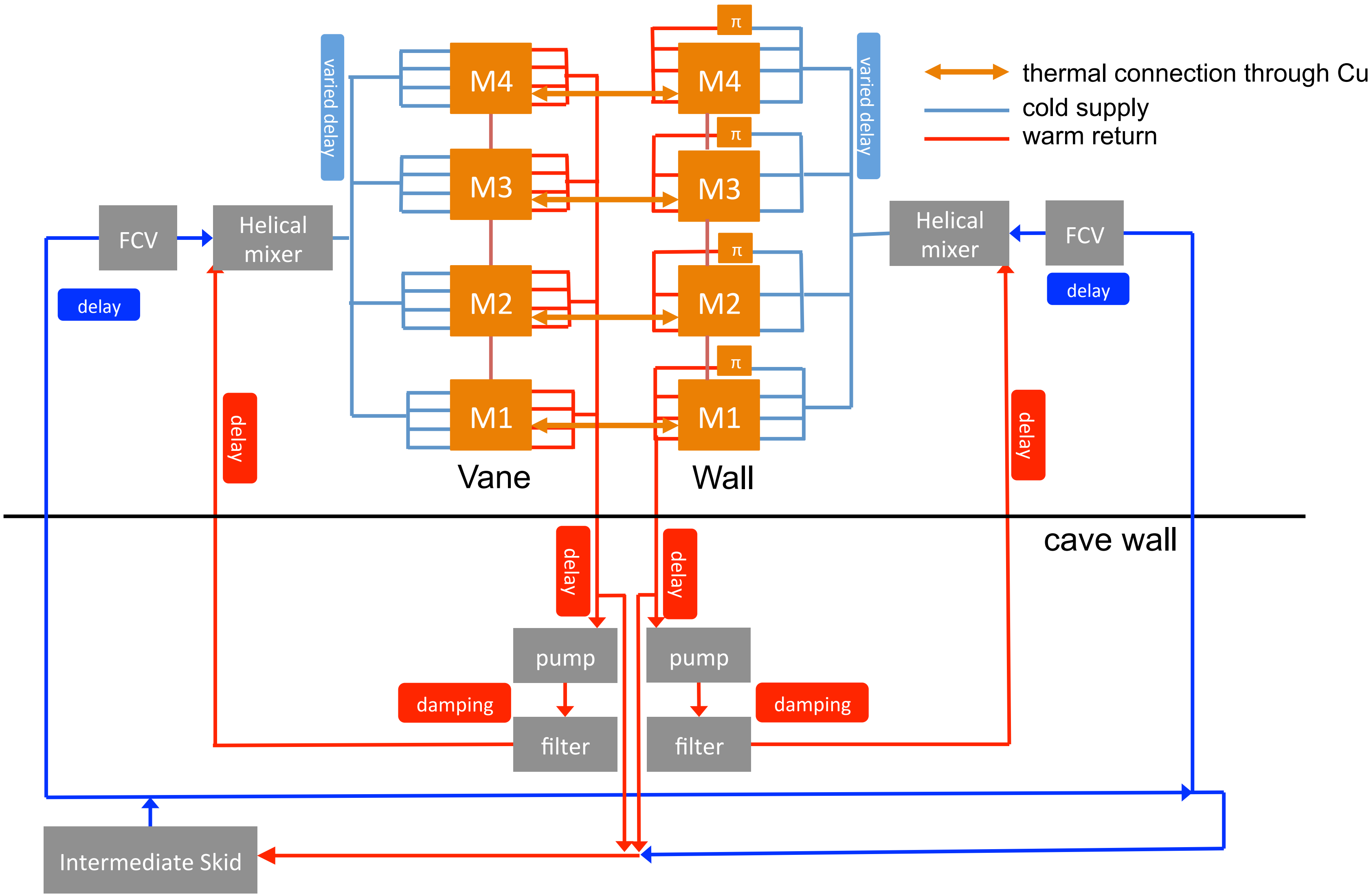
Objectives

- Exercise the water system as much as possible
- Evaluate how changes in the water system change the resonant frequency
- Begin to develop table of time constants

Overview

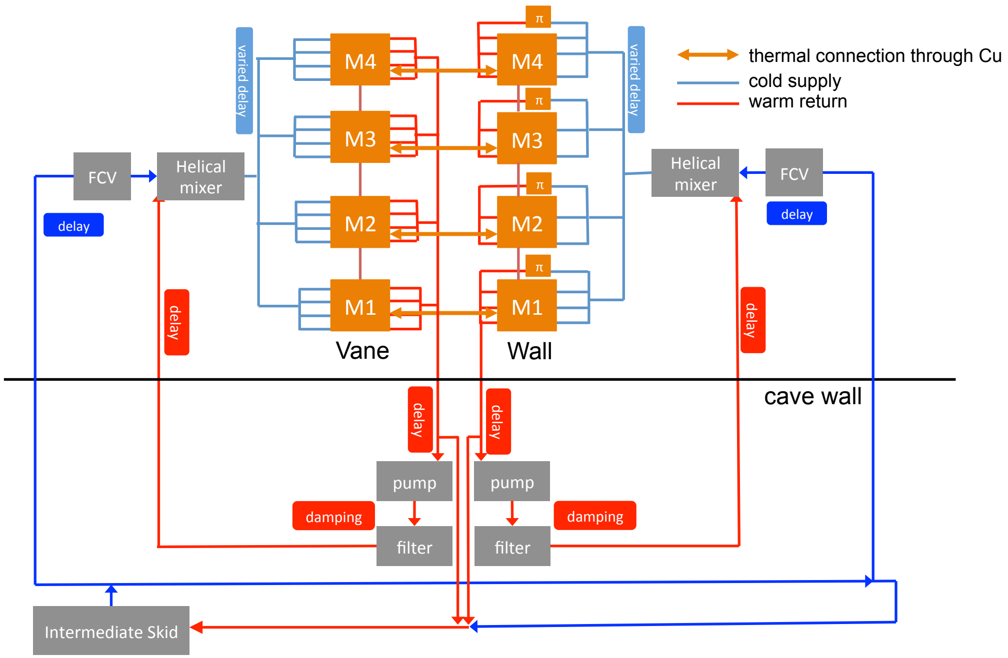
- Brief overview of the water system
- Testing conditions
- Initial frequency response data
- Notable observations
- Additional characterization studies needed

Water system overview



Testing conditions

- Varied the vane control valve settings and the intermediate skid temperature.
- Wall flow valve was not operable
- Network analyzer connected to temporary couplers and tracking resonant frequency



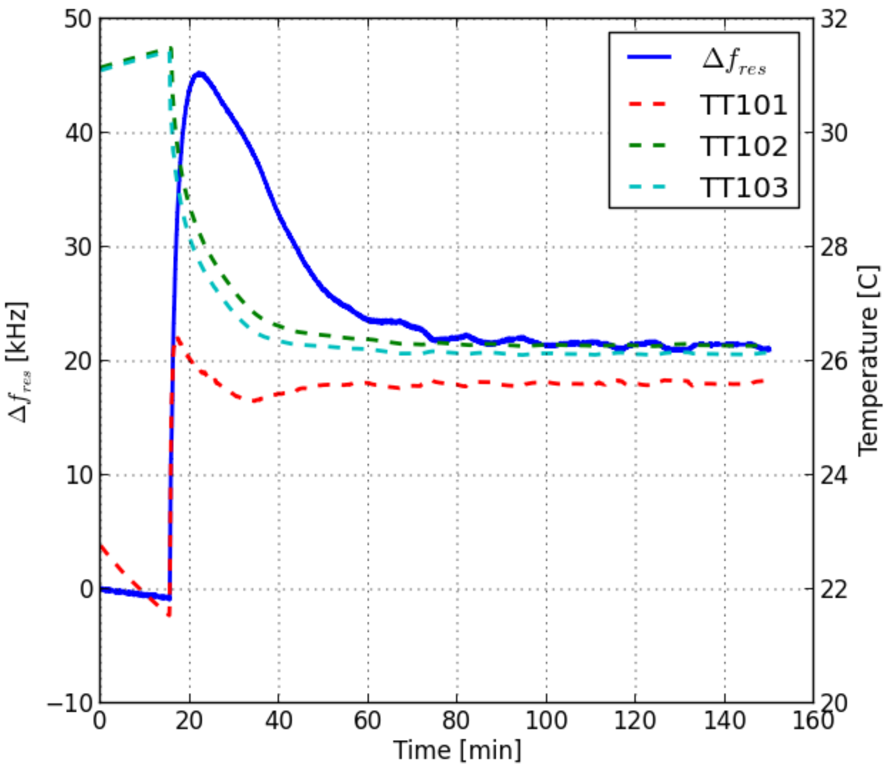
Study	Conditions	Purpose
Frequency response	At steady state: close flow valves, change intermediate skid temperature, wait for skid to settle, open flow valves	Studies the resonant frequency response to water system input
Intermediate skid regulation	At steady state, change intermediate skid temperature	Studies the response of the intermediate skid
Flow curve	Step vane flow valve, plot valve percent open vs. measured flow	Measures the flow curve for vane mixing valve

RFQ vane system step response

	initial	transient	steady state
Time	0	7.2 min	115.4 min
Δf_{res}	0	46.13 kHz	21.15 kHz
TT_{101}	22.280 ^{o}C	25.796 ^{o}C	25.649 ^{o}C
TT_{102}	31.489 ^{o}C	28.126 ^{o}C	26.141 ^{o}C
TT_{103}	30.941 ^{o}C	27.639 ^{o}C	26.284 ^{o}C

flow path	time delay [s]
$TT_{101} \rightarrow TT_{103}$	1.0
$TT_{103} \rightarrow TT_{102}$	17.0

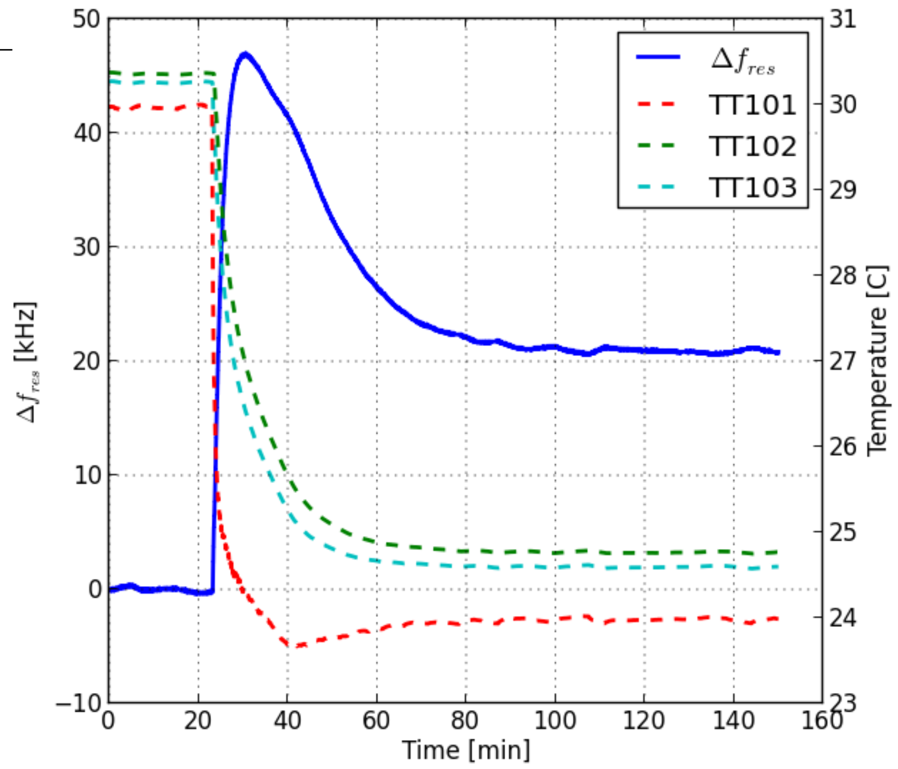
- Transient response of the RFQ resonant frequency due to change in the vane flow control valve. Prior to changing the flow valve, the intermediate skid was cooled to approximately 25C. The control valve was stepped from 0% open to 50% open.



RFQ vane system step response

	initial	transient	steady state
Time	0	7.9 min	124.2 min
Δf_{res}	0	47.38 kHz	20.80 kHz
TT_{101}	29.962 ^oC	24.278 ^oC	23.988 ^oC
TT_{102}	30.364 ^oC	26.910 ^oC	24.763 ^oC
TT_{103}	30.263 ^oC	26.371 ^oC	24.594 ^oC

- Transient response of the RFQ resonant frequency due to change in intermediate skid temperature. The flow control valve was set to 50% open, then the skid temperature was decreased to 25C. Note that the steady state value is lower than 25C



Observations about the system

- *Valve operation*
  - Lower limit on the vane Kammer valve of about 2% open and 5 gpm
  - Maximum flow achieved at about 80% open
  - Changes in the flow valve were tripping off the intermediate skid and vane/wall pump. To mitigate this, the bypass valve on the intermediate skid circuit was adjusted.
- *PLC*
  - Kammer valve setting vs. read-back needs to be calibrated further
- *RFQ frequency response*
  - Transient looks less severe than examples from RF heating– this makes sense
- *Intermediate Skid*
  - ~ 1-°C difference at the 25-°C skid set point
  - Would be nice to have temperature at the intermediate skid in ACNET
  - Would be nice to be able to control intermediate skid remotely

Way forward

System characterization w/o power

- Need to characterize wall system
- Need to Exercise systems together
  - Verify we do not trip the pumps from changing the valve settings
  - Measure flow curves
- Re-characterize system with both circuits operational

System characterization w/ power

- Parameter scan style stepping through combinations of flow valve settings and different average RF power levels
- Need to obtain system time response from RF heating