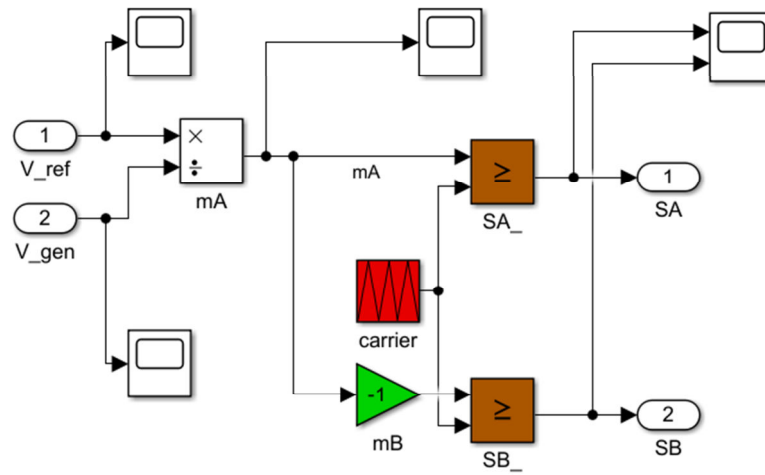
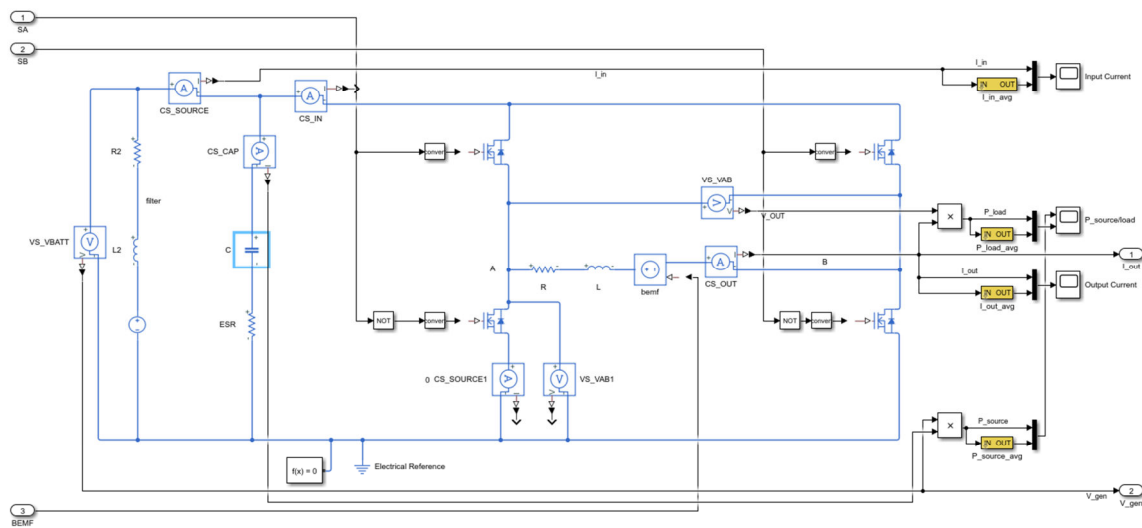


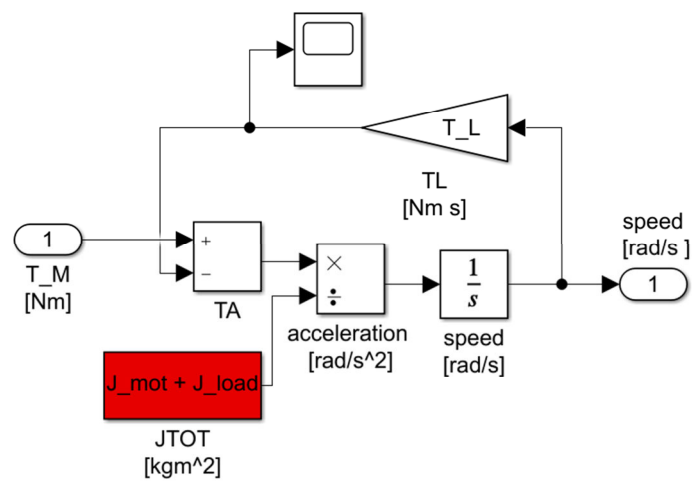
FINAL REPORT YEAR 2020/2021



PWM modulation subsystem



Real 4 quadrant DC/DC converter subsystem



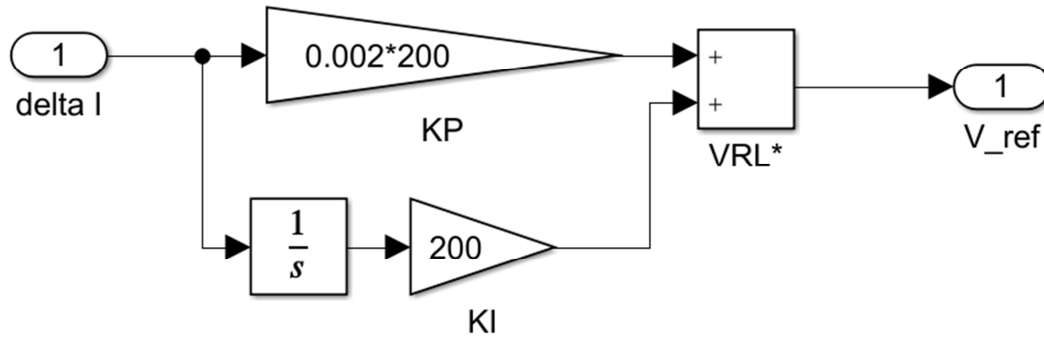
Mechanical load subsystem

```

% PI Current Regulator tuning
%  $G(s) = 1 / (L*s + R)$ 

g_I = tf([1],[2.62e-3 10.2]);
rltool

```



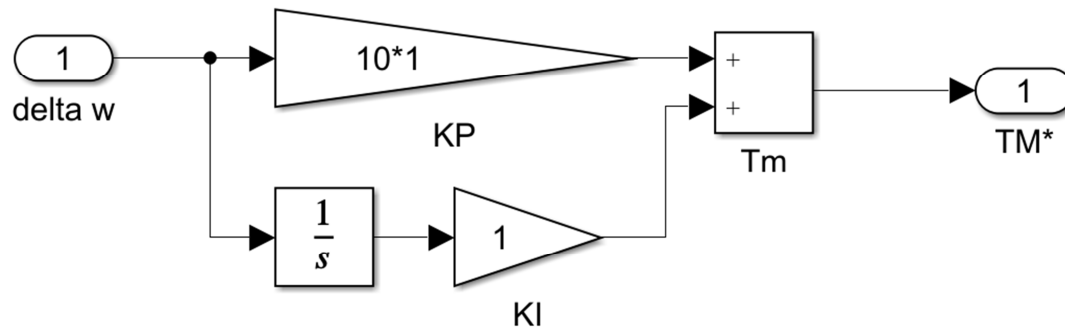
PI current regulator tuning and subsystem

```

% PI Speed regulator tuning
%  $G(s) = 1 / (J_{tot}*s + K_L)$ 

g_w = tf([1],[266e-3 4.355e-4]);
rltool

```

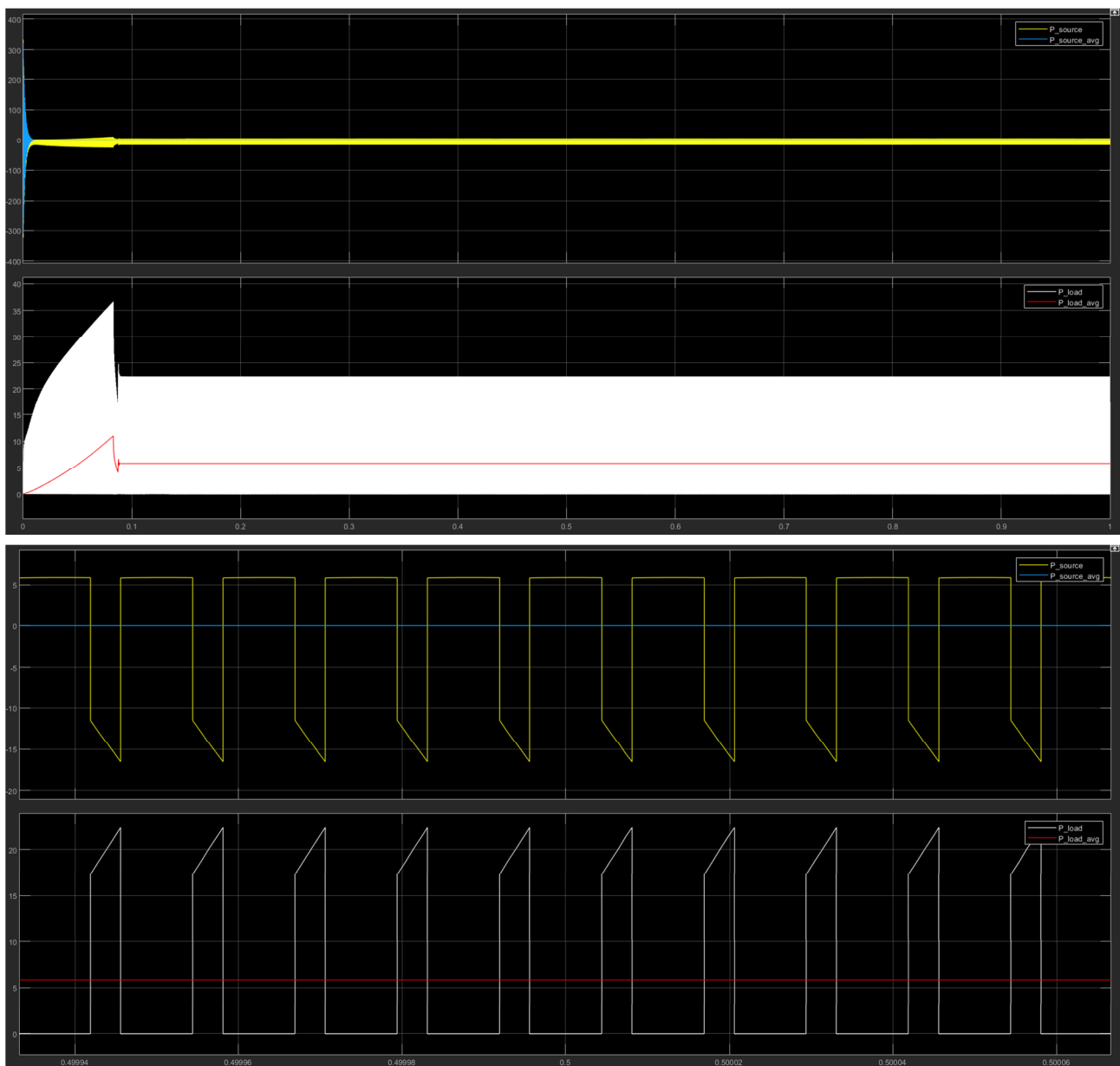


PI speed regulator tuning and subsystem

Parameters of the control scheme

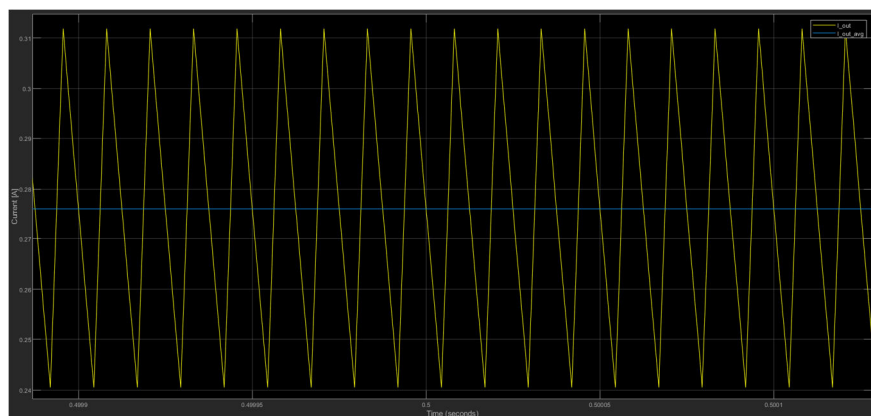
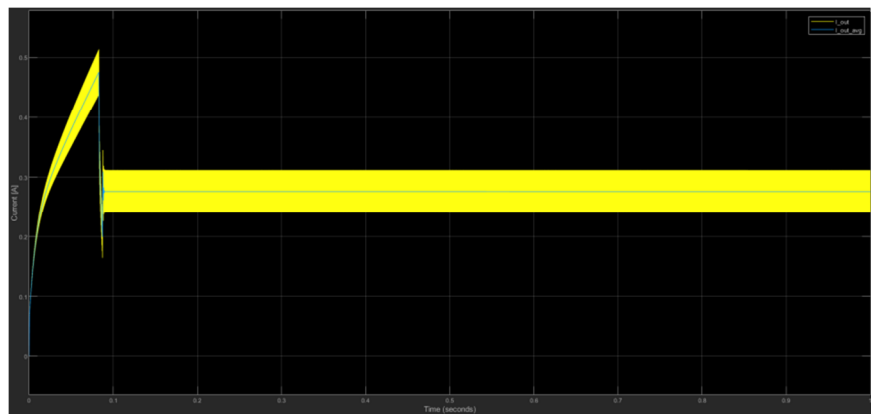
Carrier frequency	kHz	40
Filter resistance	m Ω	10
Filter capacitance	μ F	5
Max current saturation	A	1.71
PI current regulator KI	\	200
PI current regulator KP	\	0.4
PI speed regulator KI	\	1
PI speed regulator KP	\	10

Power measurements in source and load sections

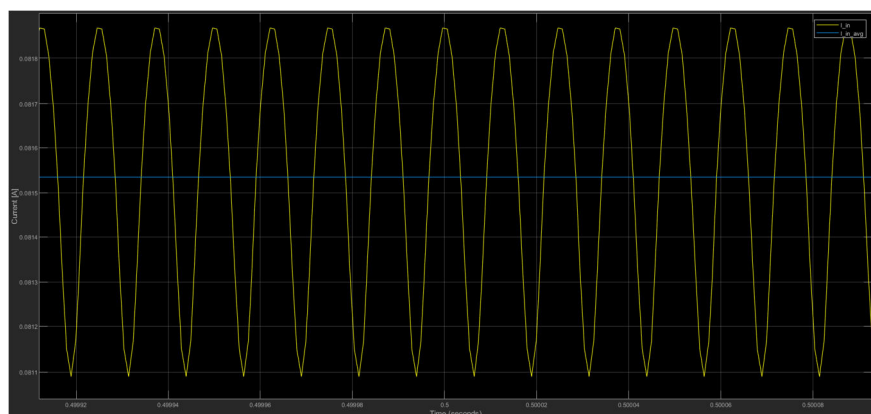
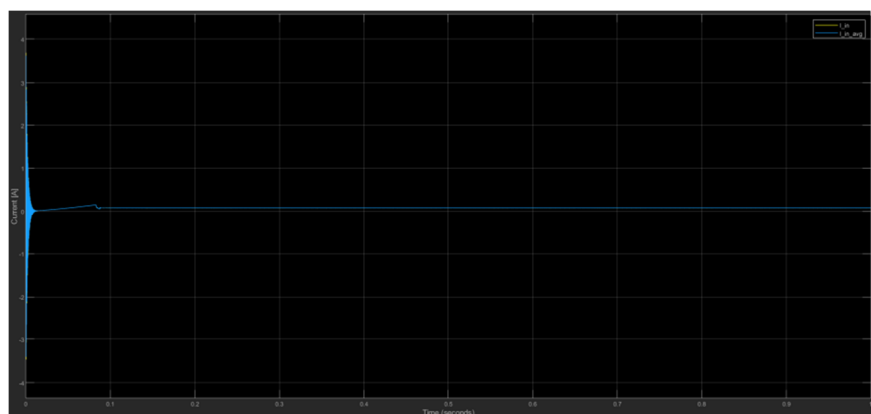


Power in source and load - Full view and detail

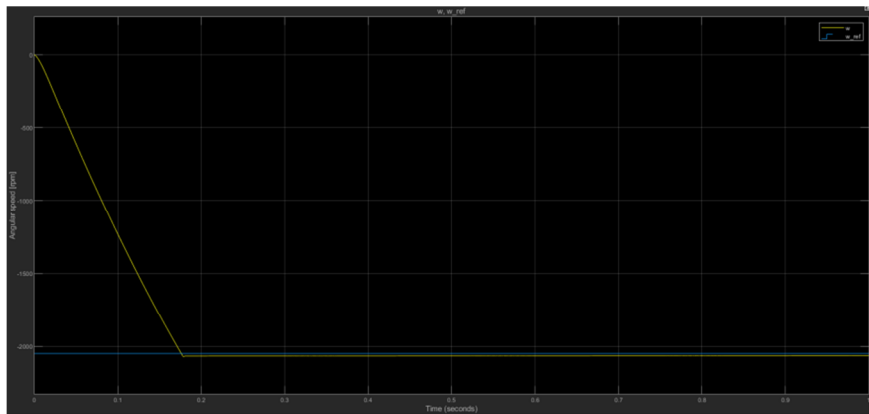
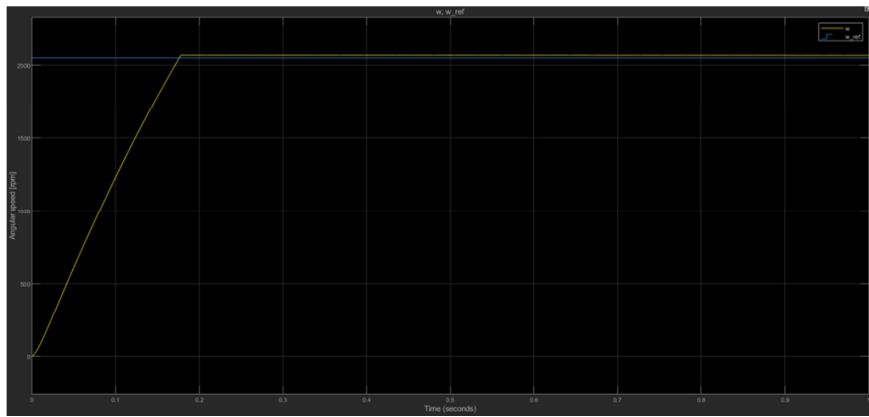
Performance diagrams



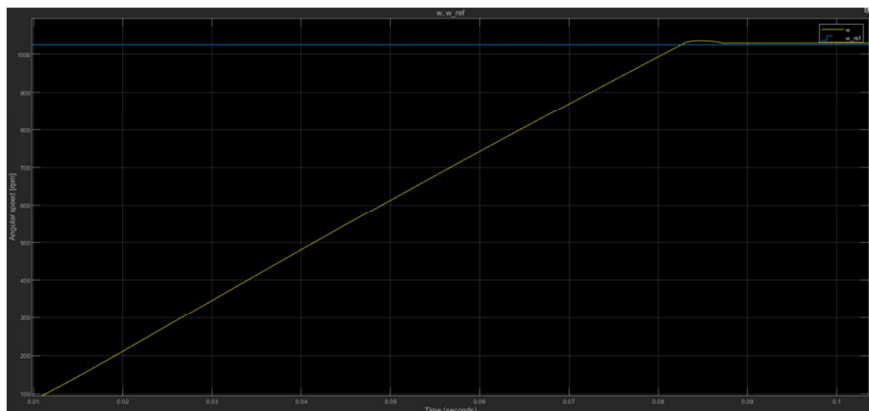
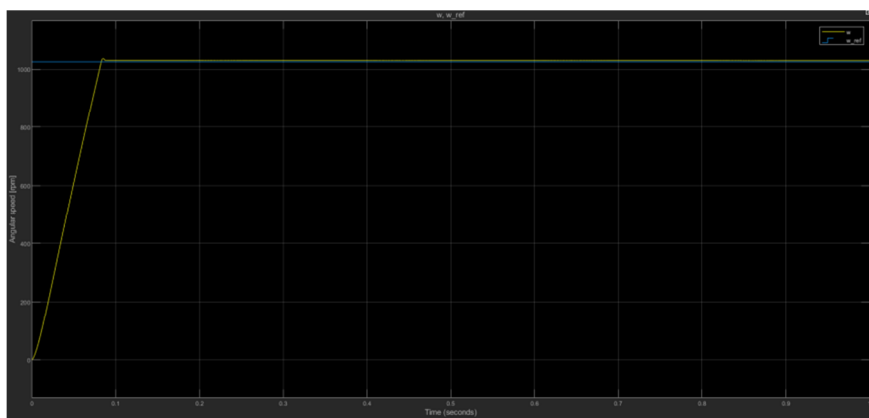
Output current - Full view and detail



Input current - Full view and detail



Speed range - 100% and -100% of nominal speed



Motor speed - Full view and detail

Final results

Output current ripple at high frequency in steady state operation [$I_{pk-pk} / I_{OUT_nominal}$]	0.0713 / 1.10	6.48%
Input current ripple at high frequency in steady state operation [$I_{pk-pk} / I_{SOURCE_mean}$]	$0.776 \cdot 10^{-3} / 81.5 \cdot 10^{-3}$	0.95%
Speed overshoot in step response from 0 to 50% of nominal speed [$(w_{MAX} - w_{ref}) / w_{ref}$]	9.48 / 1025	0.92%
Steady state speed error at 50% of nominal speed [$(w_{steady-state} - w_{ref}) / w_{ref}$]	3.95 / 1025	0.38%
Rise time to go from 0 to 50% of nominal speed [$t_{90\%} - t_{10\%}$]	0.0743 – 0.0116	62.7 ms