## **Objective Convergence vs Time (loglog) Objective Convergence vs Iterations (loglog) GRAVIDY-St (Fast)** GRAVIDY-St (Fast) $10^{2}$ 10<sup>2</sup> **GRAVIDY-St (NR-Dense) GRAVIDY-St (NR-Dense)** Wen-Yin Cayley Wen-Yin Cayley **Objective Value Objective Value** RGD-QR RGD-QR $10^{1}$ $10^{0}$ $10^{0}$ 10<sup>-3</sup> $10^{-2}$ 10<sup>0</sup> $10^{0}$ $10^{1}$ $10^{2}$ 10<sup>3</sup> $10^{4}$ $10^{-4}$ $10^{-1}$ $10^{1}$ Time [seconds] **Iterations Feasibility vs Iterations** Feasibility vs Time GRAVIDY-St (Fast) GRAVIDY-St (Fast) $10^{-9}$ $10^{-9}$ **GRAVIDY-St (NR-Dense) GRAVIDY-St (NR-Dense)** Feasibility: $\|X^{\top}X - I\|_F$ Feasibility: $\|X^\top X - I\|_F$ Wen-Yin Cayley Wen-Yin Cayley $10^{-11}$ RGD-QR RGD-QR $10^{-11}$ $10^{-13}$ $10^{-13}$ $10^{-15}$ $10^{-15}$ $10^{-17}$ $10^{-17}$ 40000 50000 10 12 10000 20000 30000 6 14

**Iterations** 

Time [seconds]