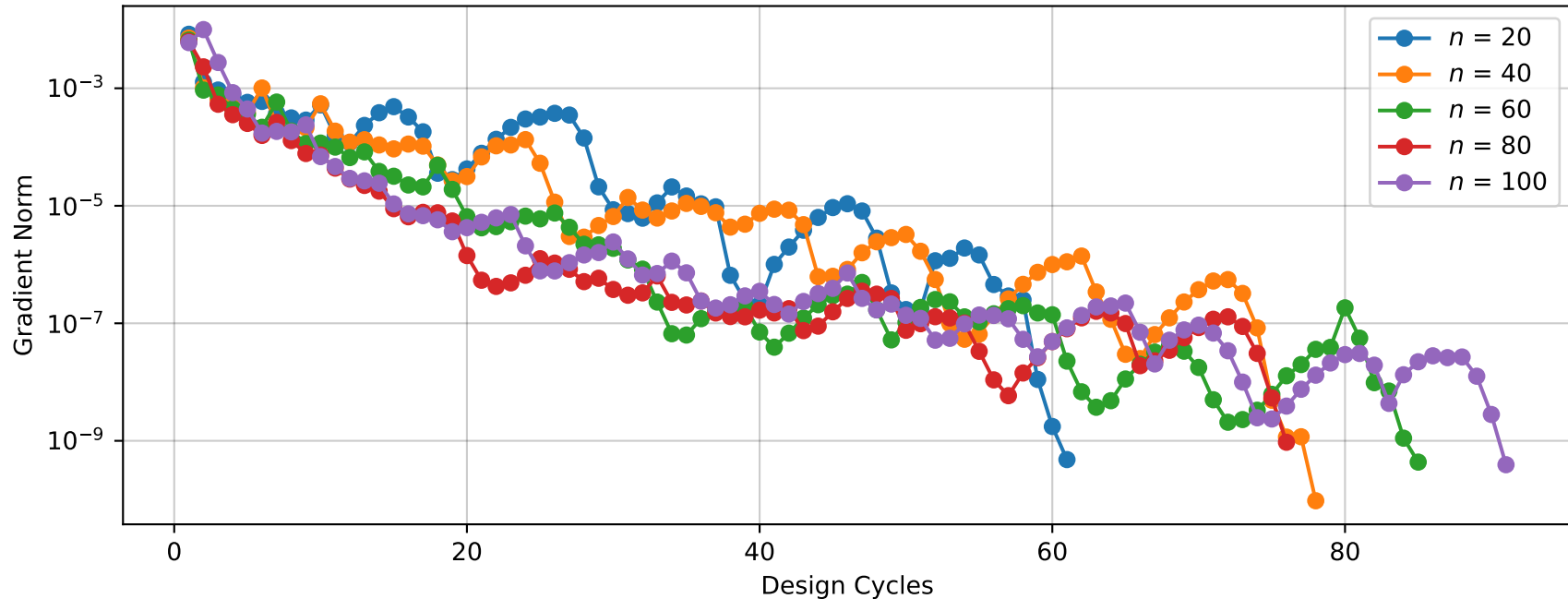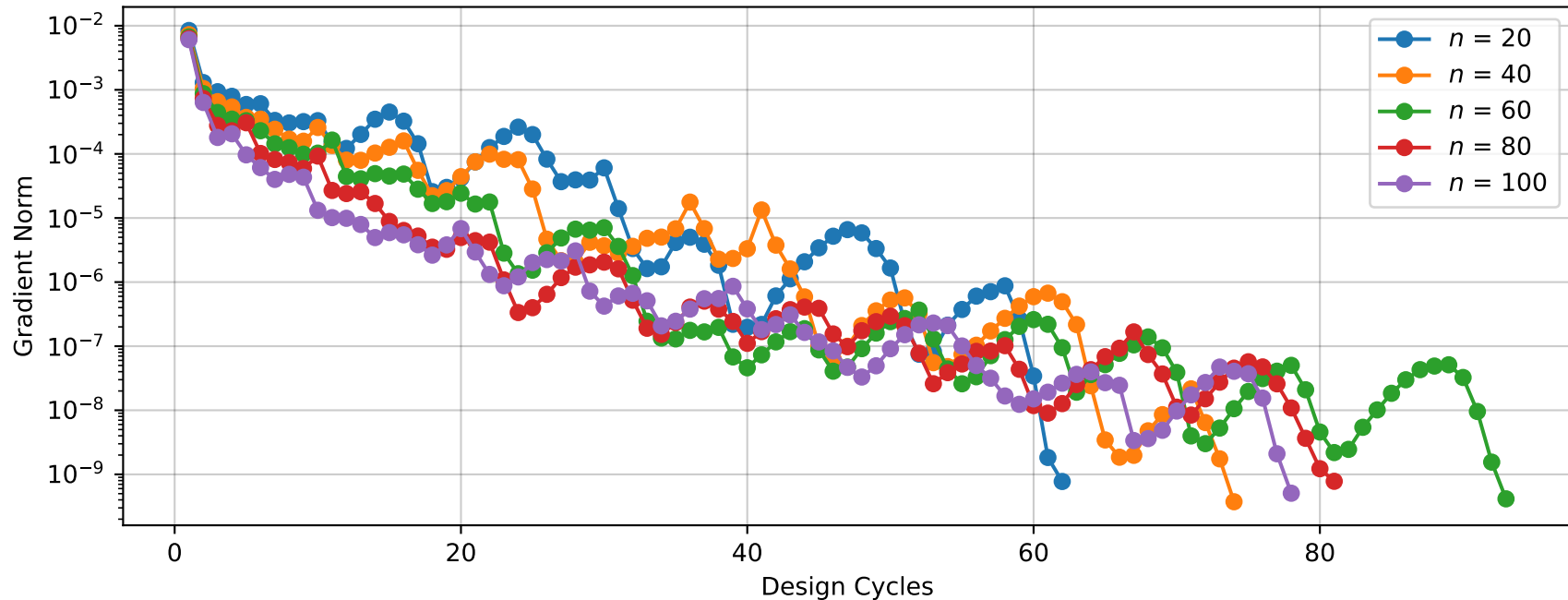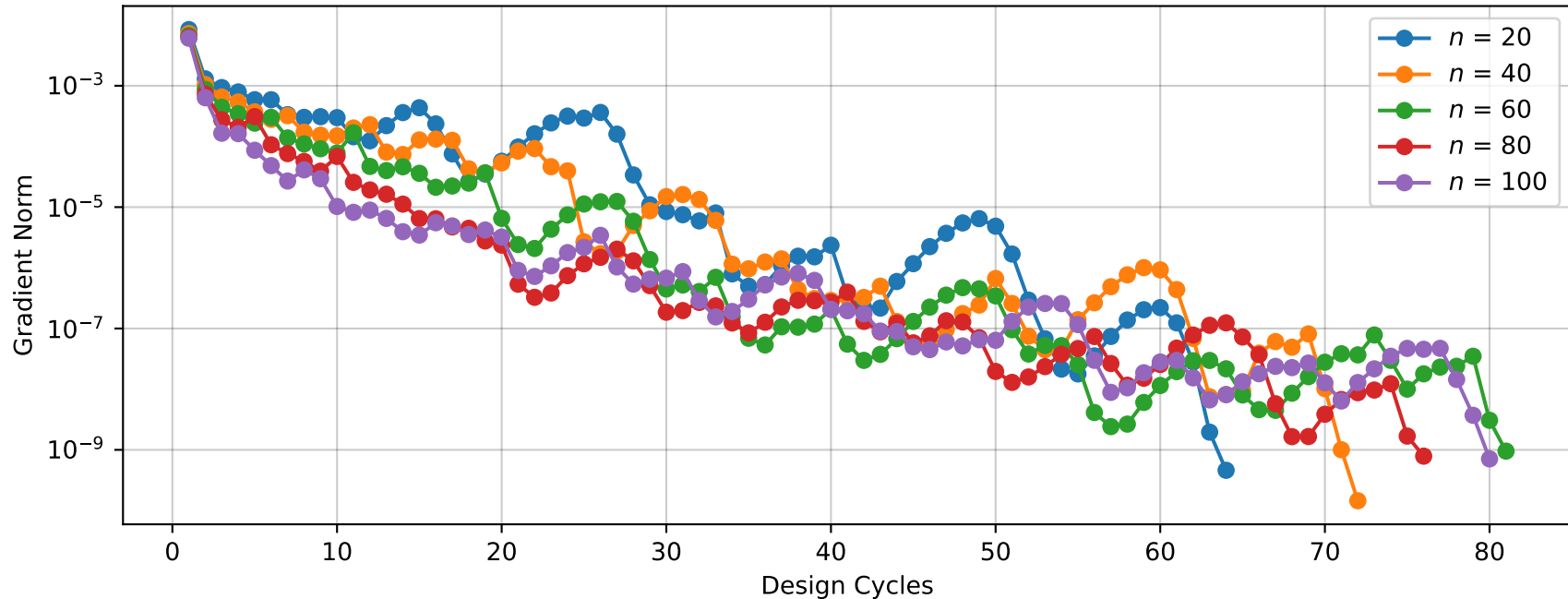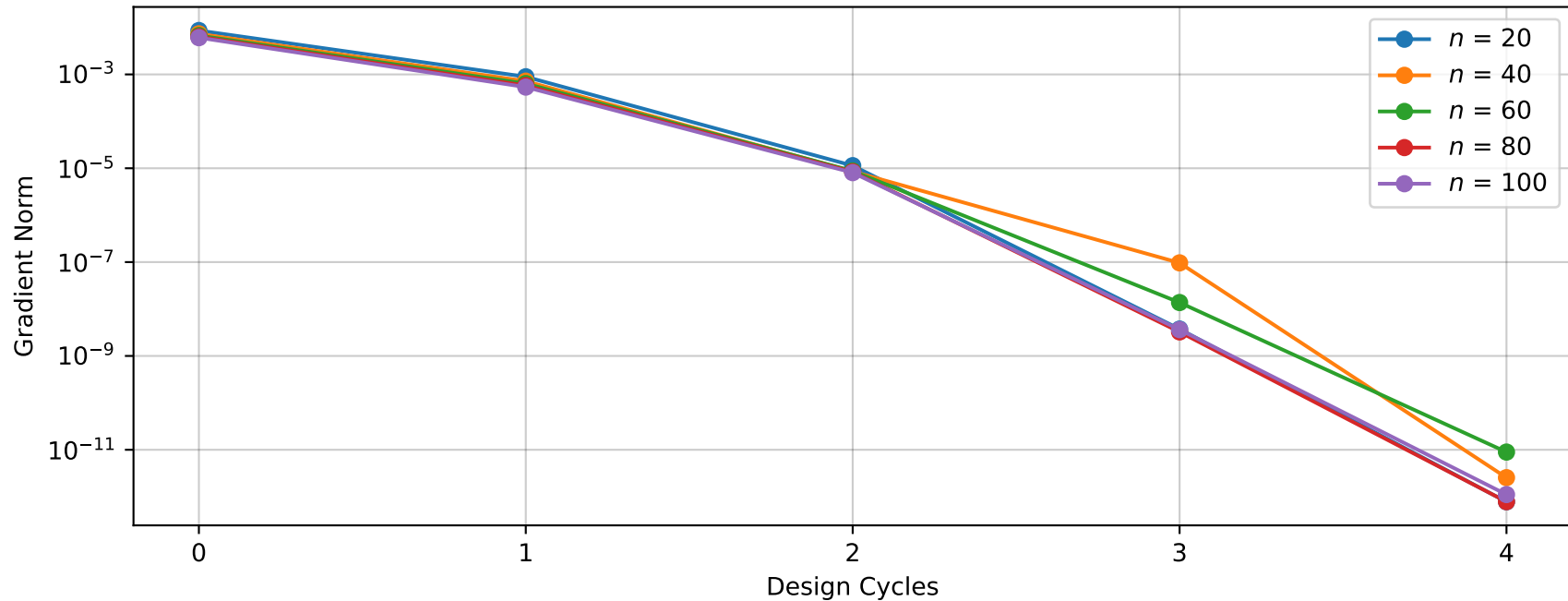Reduced-space BFGS Gradient vs Design Cycles, $m = 4000$

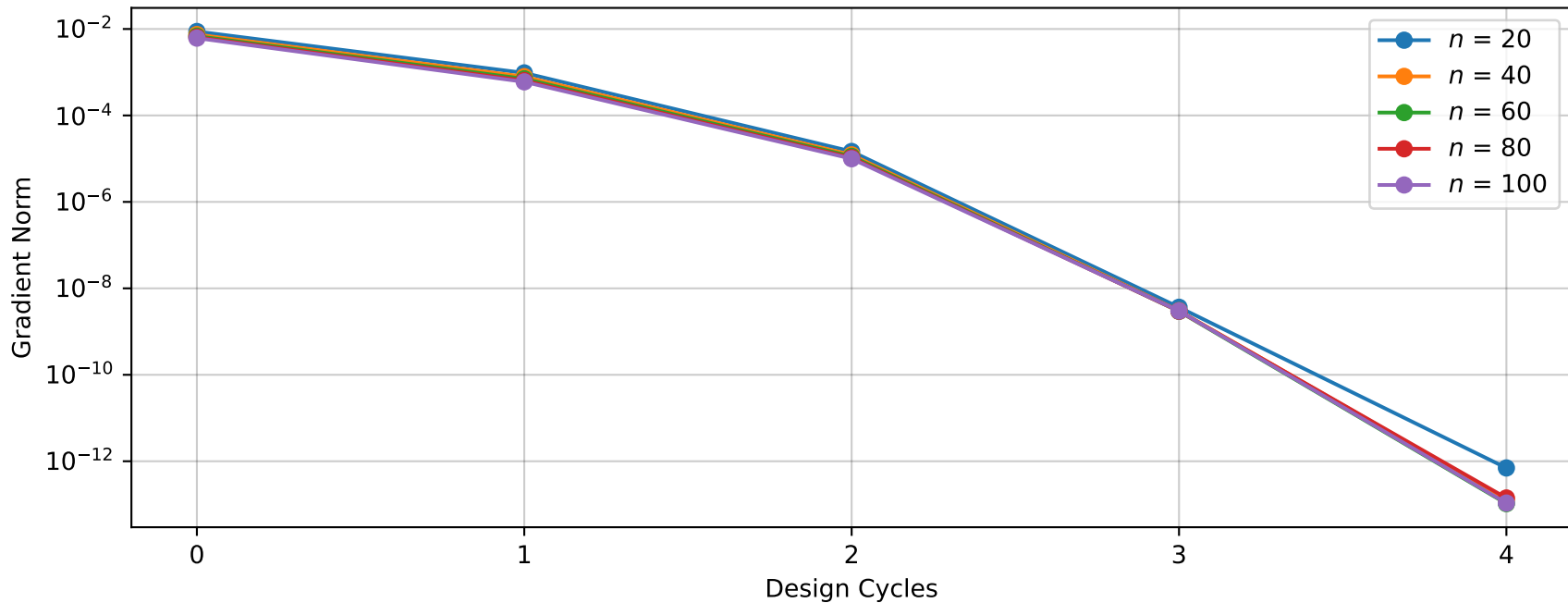Reduced-space BFGS Gradient vs Design Cycles, $m = 9000$

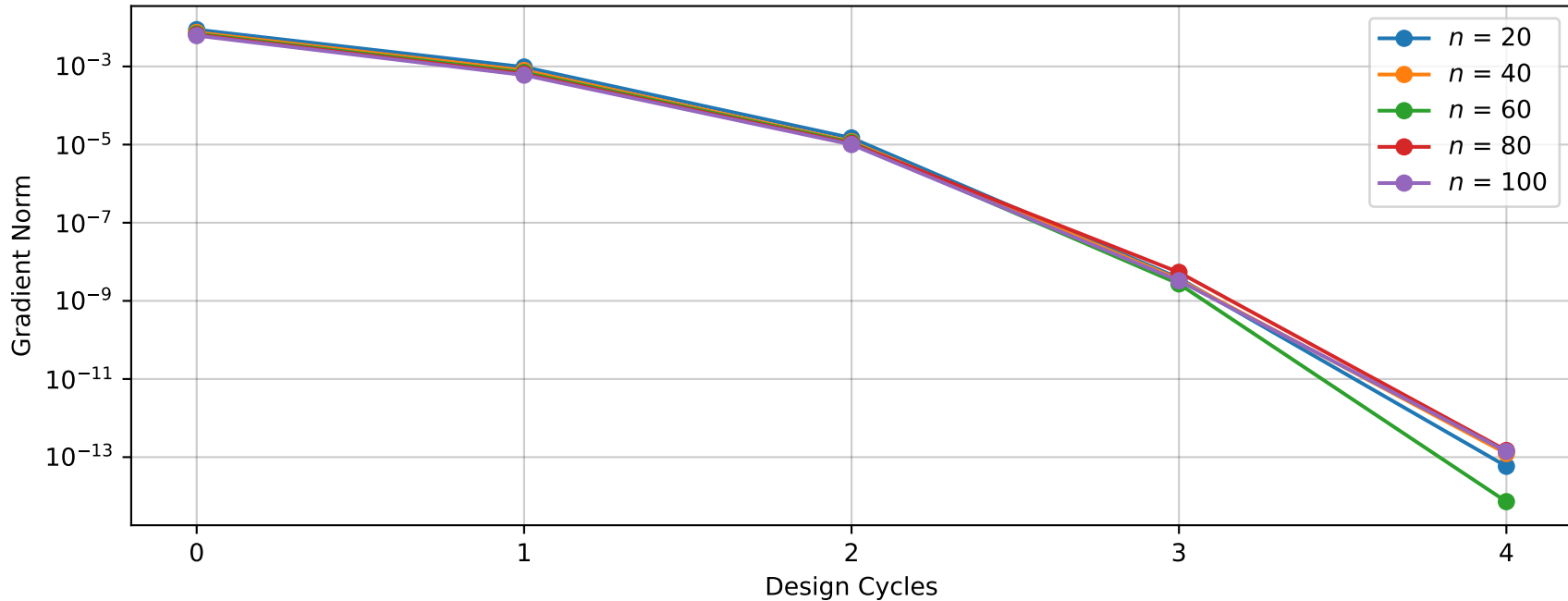Reduced-space BFGS Gradient vs Design Cycles, $m = 16000$

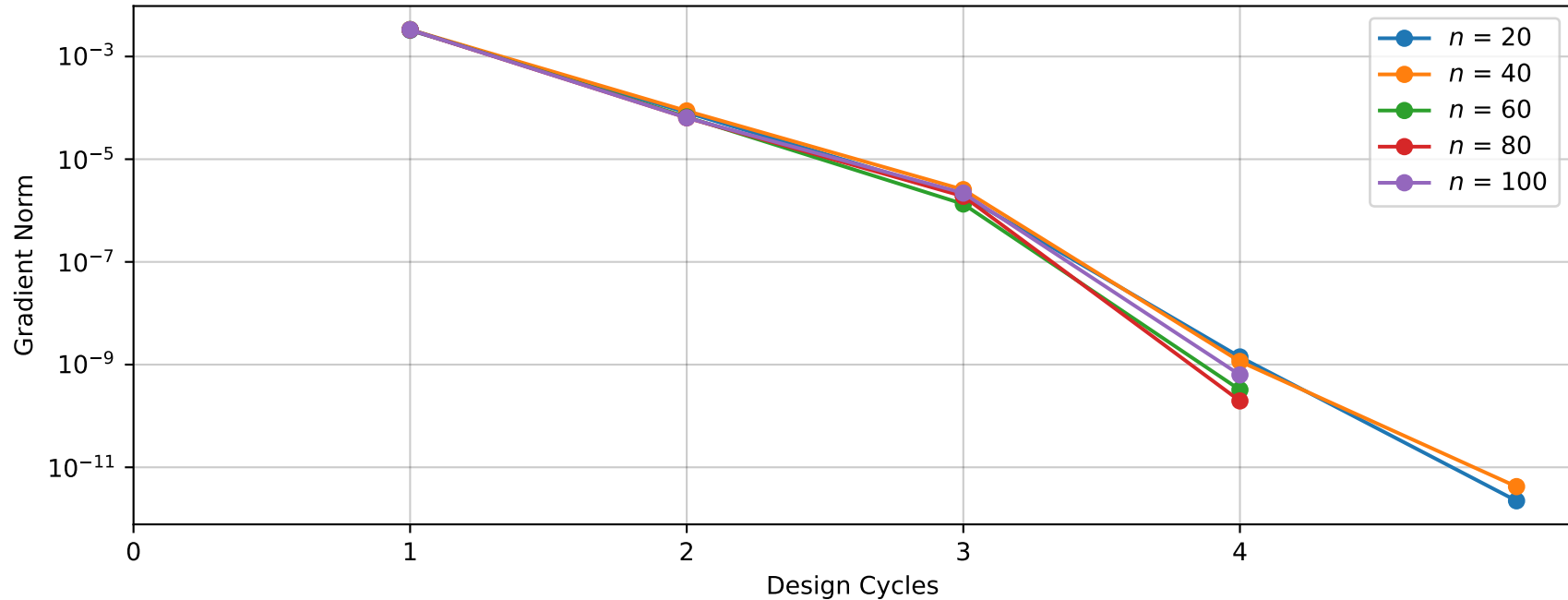Reduced-space Newton Gradient vs Design Cycles, $m = 4000$

Reduced-space Newton Gradient vs Design Cycles, $m = 9000$

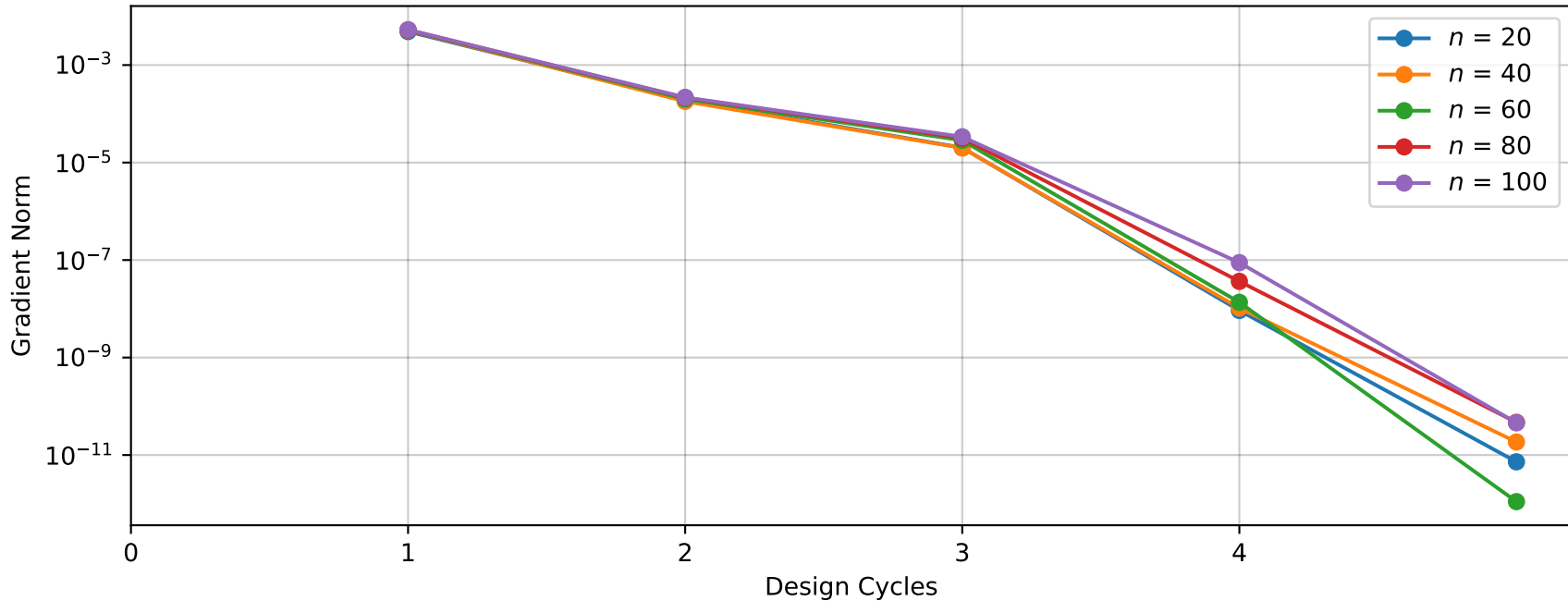Reduced-space Newton Gradient vs Design Cycles, $m = 16000$

Full-space with $\mathbf{P}_4$ Gradient vs Design Cycles, $m = 4000$

Full-space with $\mathbf{P}_4$ Gradient vs Design Cycles, $m = 9000$

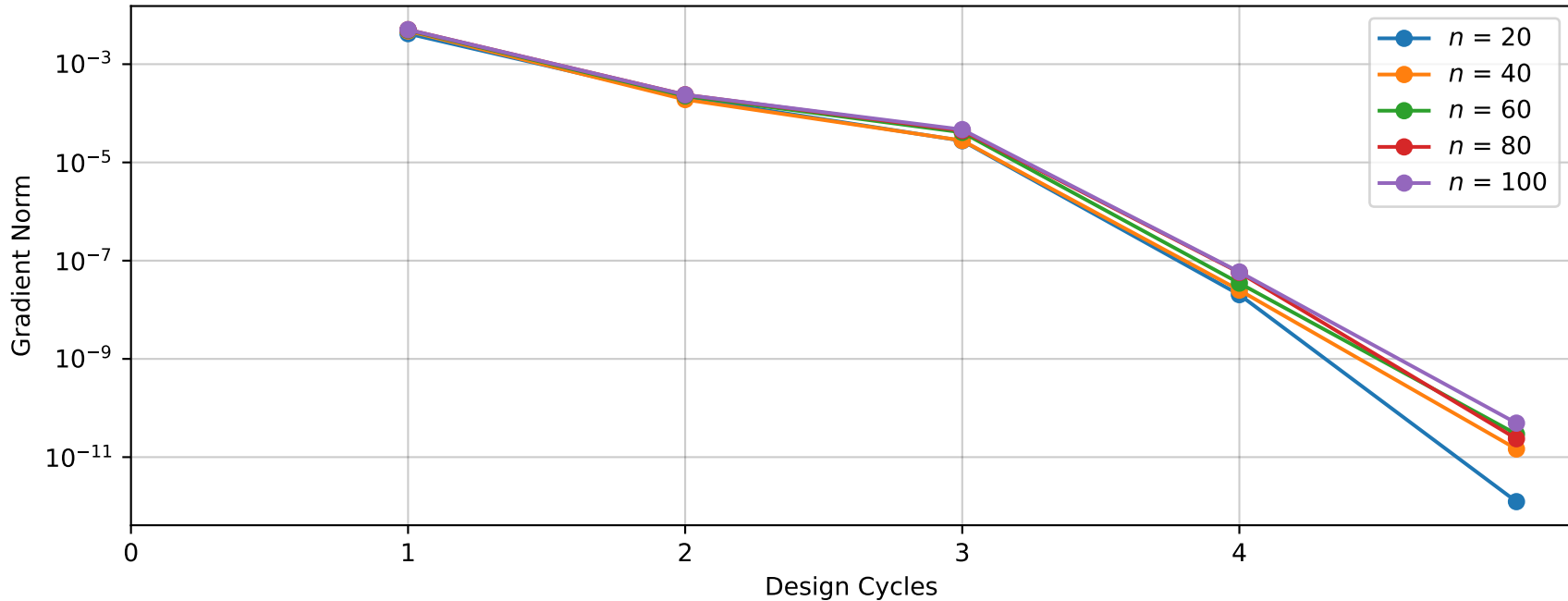Full-space with $\mathbf{P}_4$ Gradient vs Design Cycles, $m = 16000$

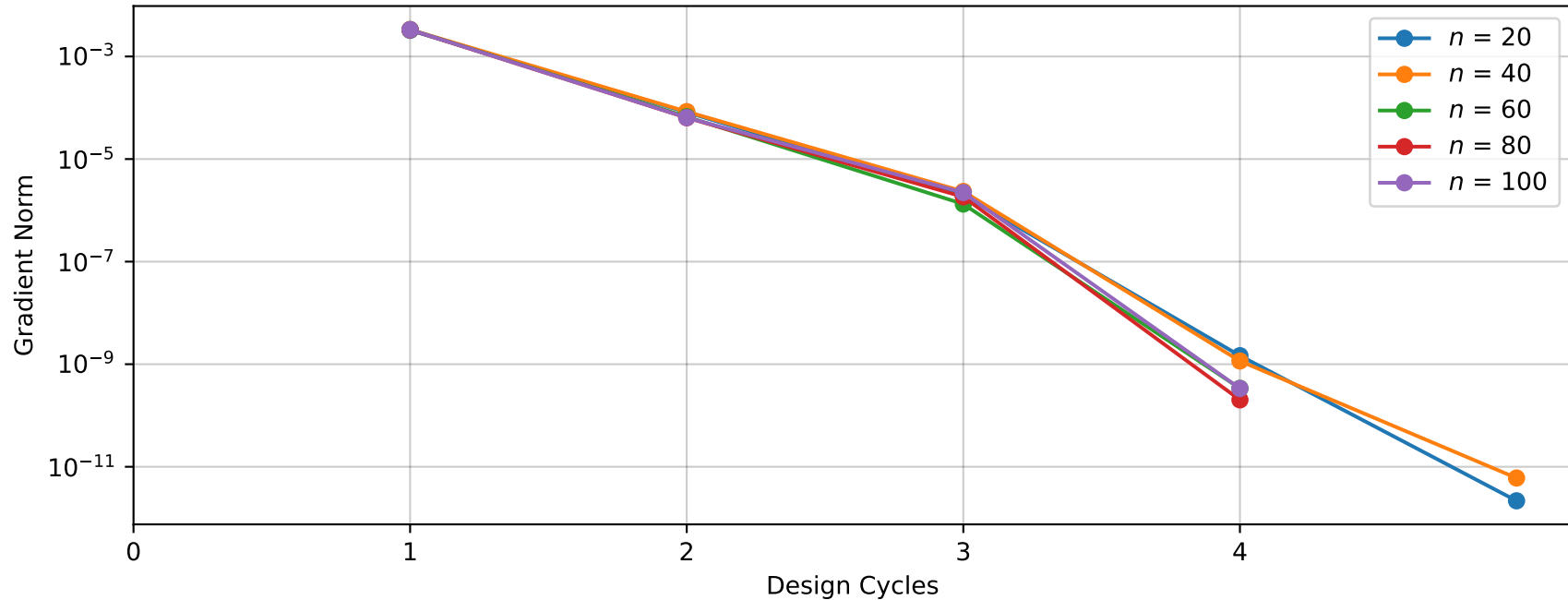Full-space with $\mathbf{P}_2$ Gradient vs Design Cycles, $m = 4000$
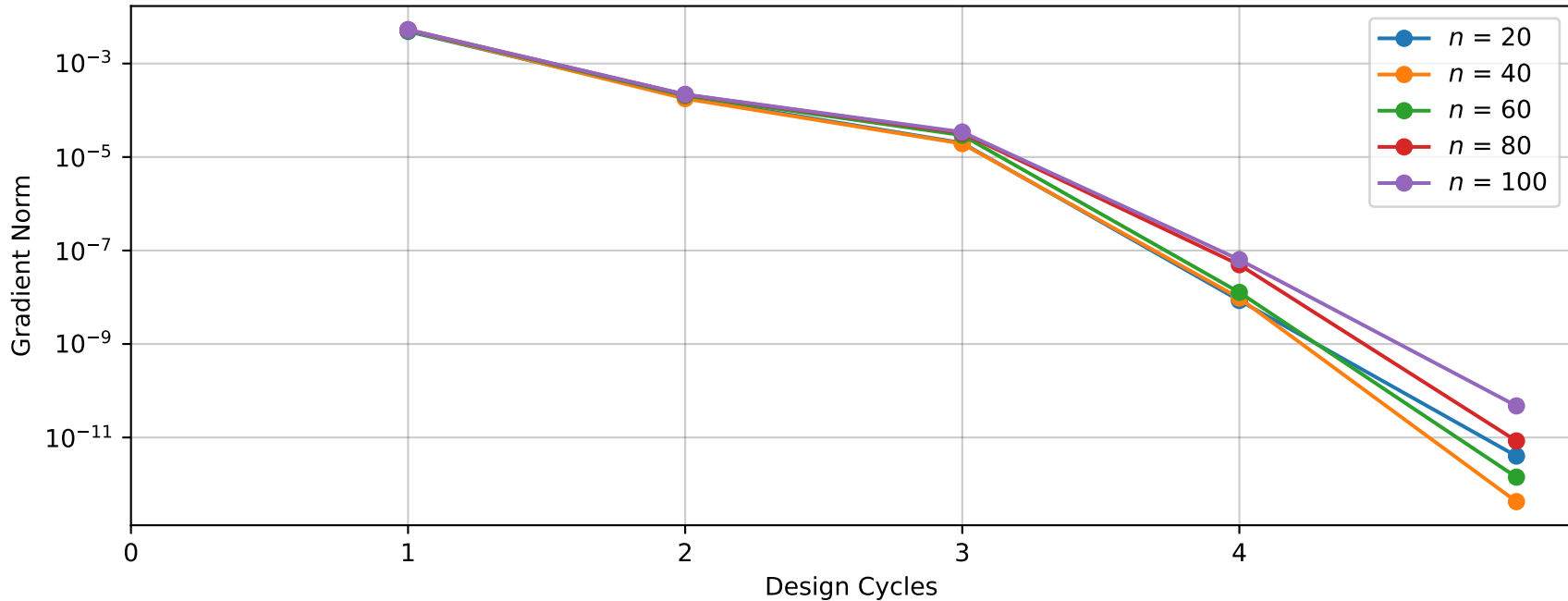
Full-space with $\mathbf{P}_2$ Gradient vs Design Cycles, $m = 9000$

Full-space with $\mathbf{P}_2$ Gradient vs Design Cycles, $m = 16000$

Full-space with $\tilde{\mathbf{P}}_4$ Gradient vs Design Cycles, $m = 4000$

Full-space with $\tilde{\mathbf{P}}_4$ Gradient vs Design Cycles, $m = 9000$

Full-space with $\tilde{\mathbf{P}}_4$ Gradient vs Design Cycles, $m = 16000$
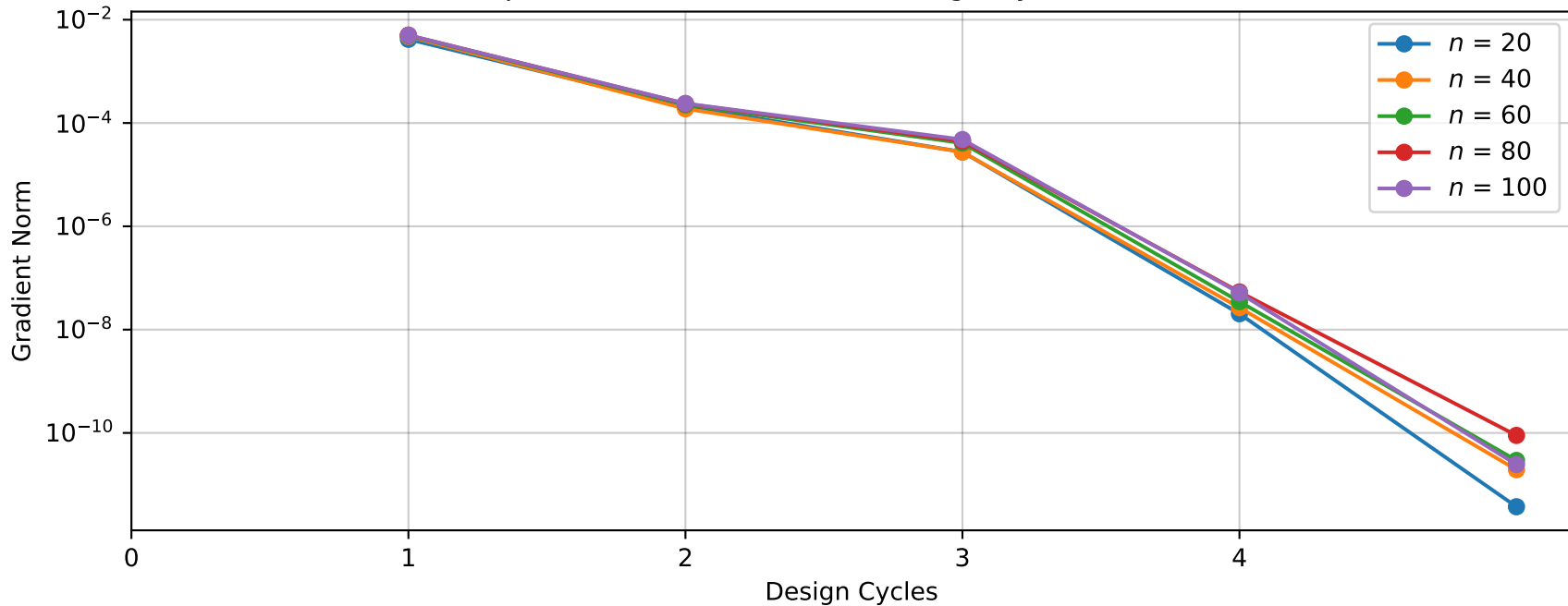
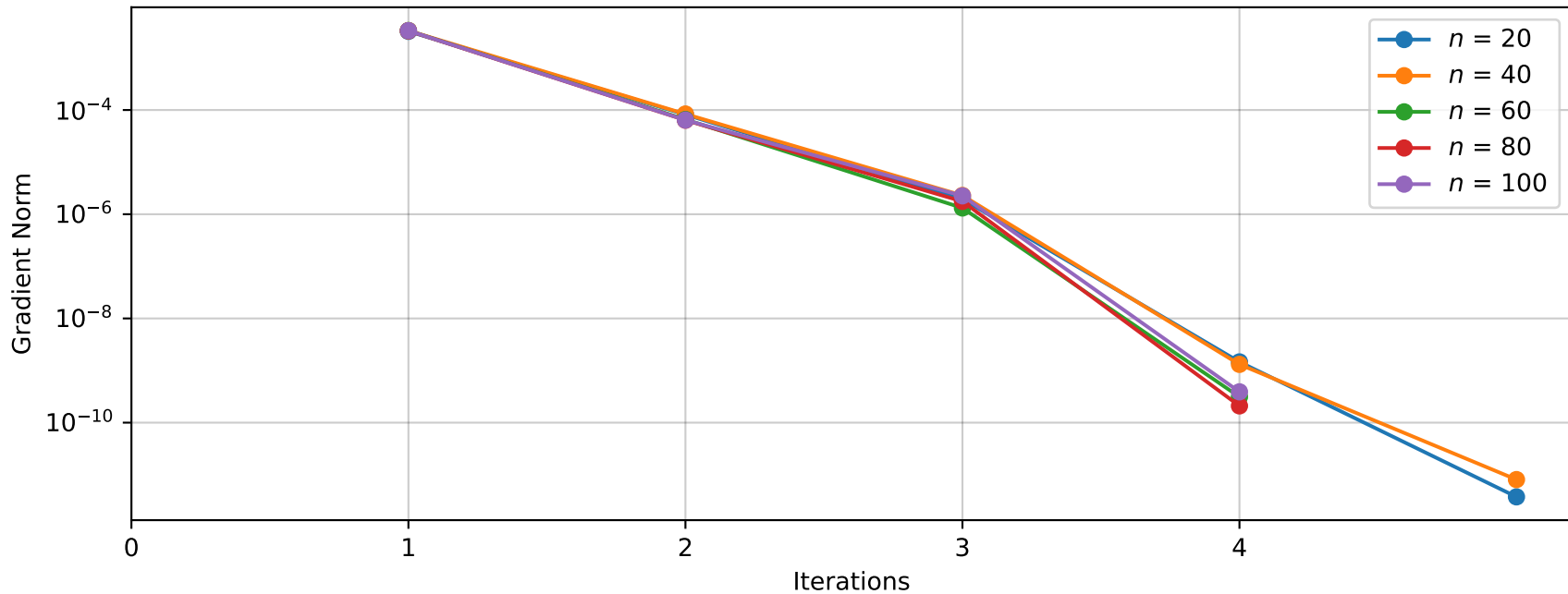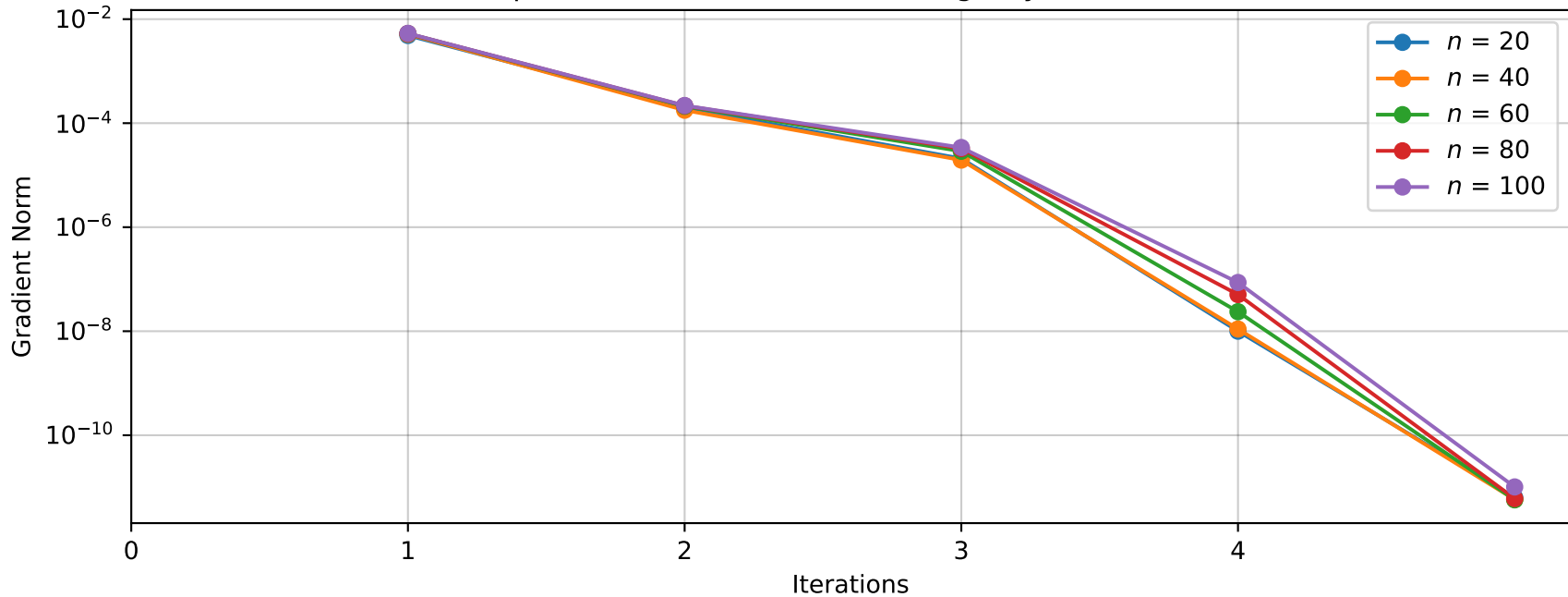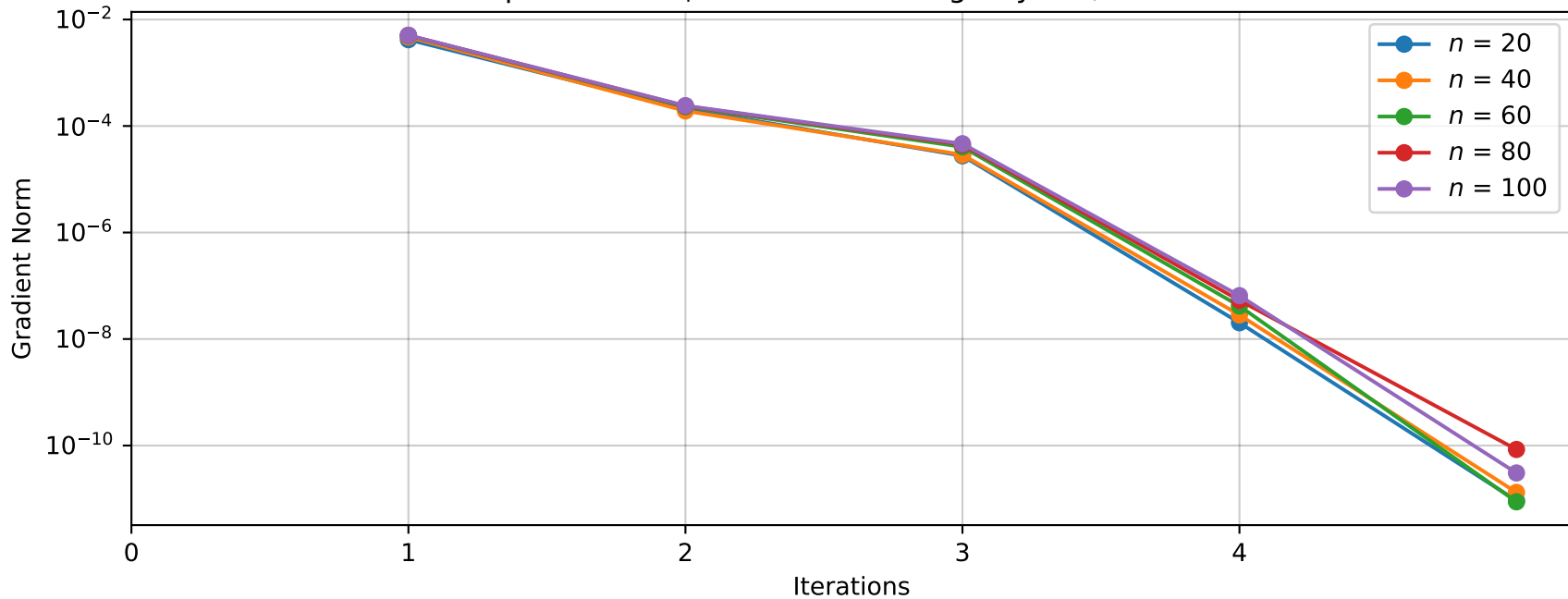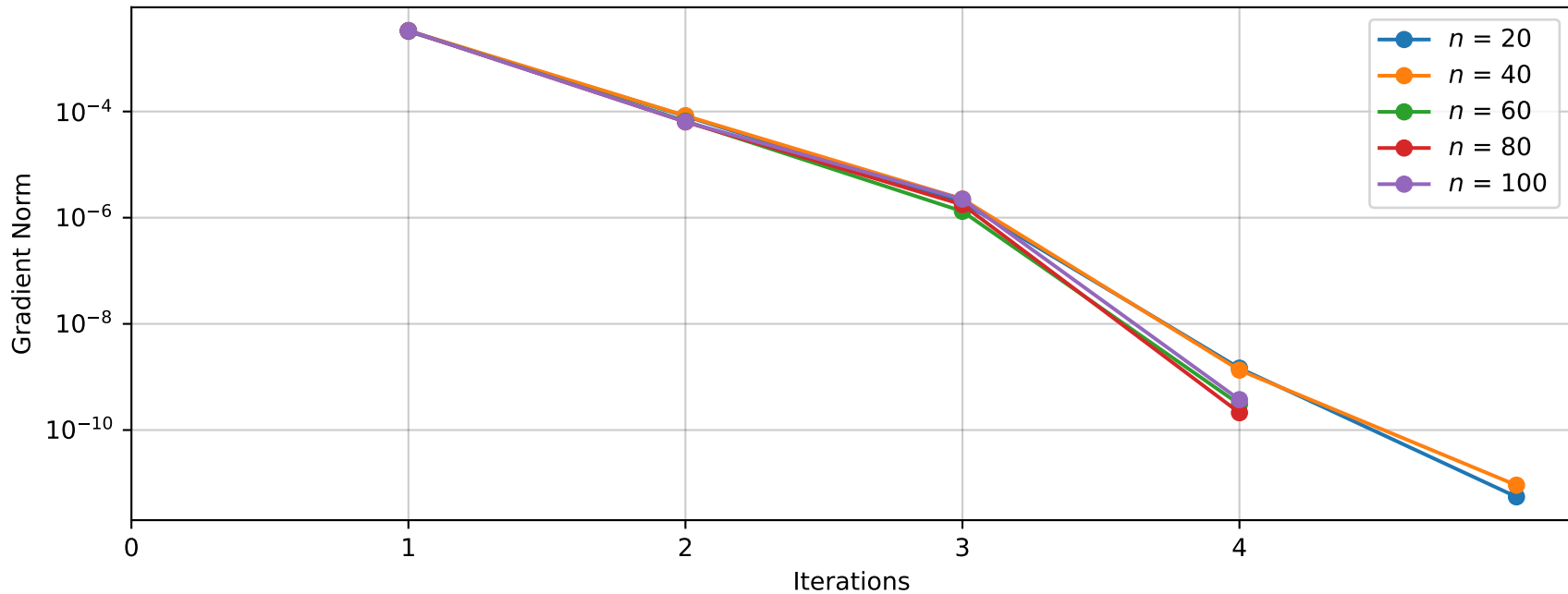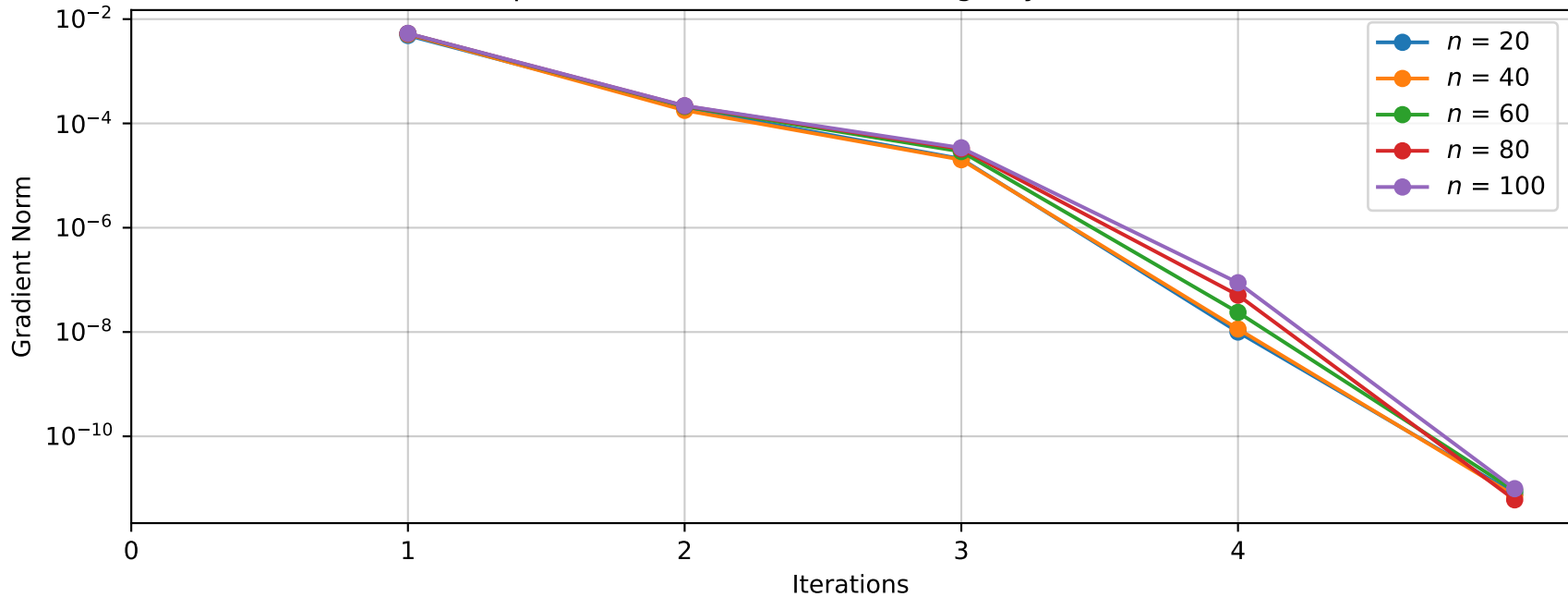Full-space with $\tilde{\mathbf{P}}_2$ Gradient vs Design Cycles, $m = 4000$

Full-space with $\tilde{\mathbf{P}}_2$ Gradient vs Design Cycles, $m = 9000$

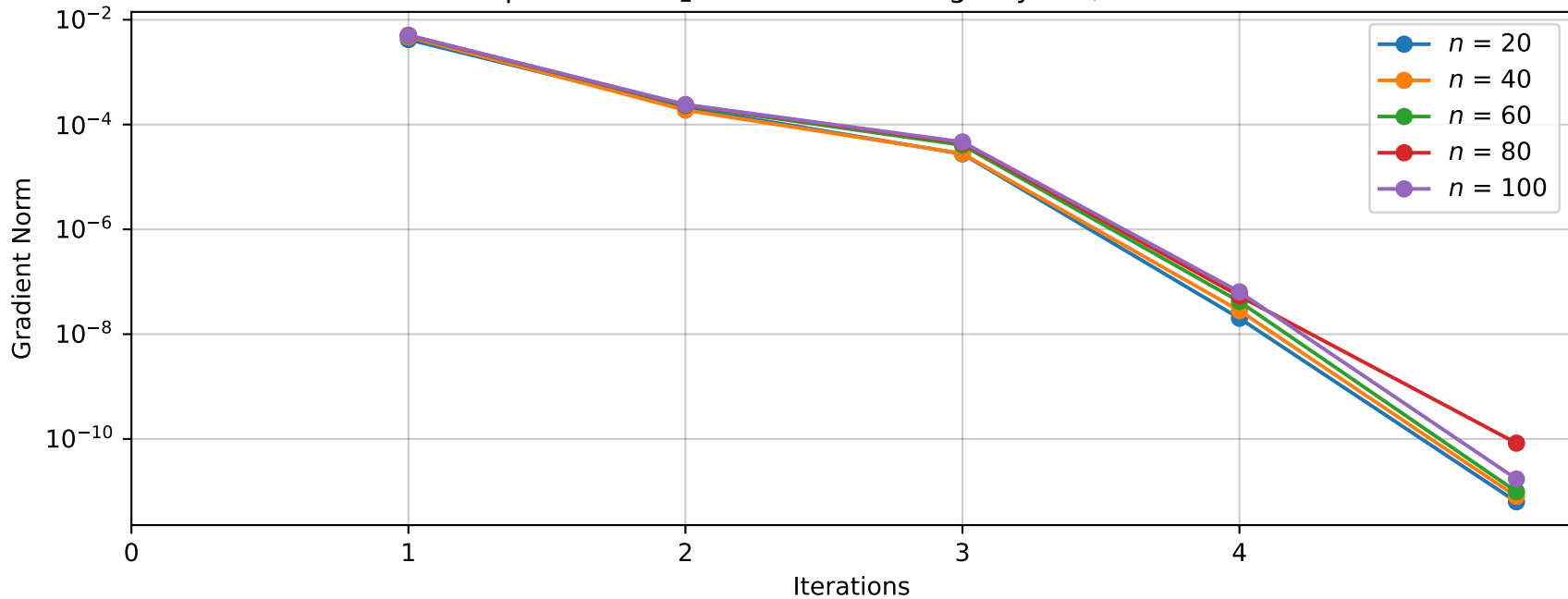Full-space with $\tilde{\mathbf{P}}_2$ Gradient vs Design Cycles, $m = 16000$

Full-space Gradient vs Subiterations, $m = 4000$

Full-space Gradient vs Subiterations, $m = 9000$
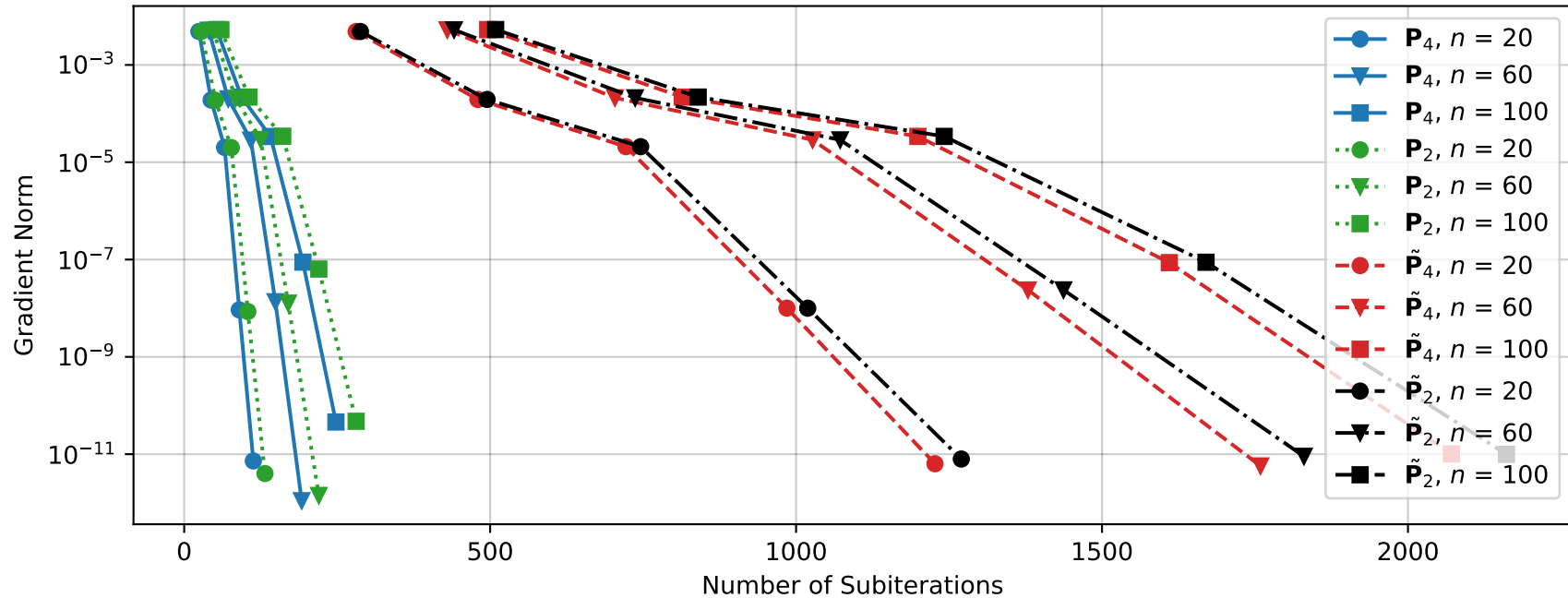
Full-space Gradient vs Subiterations, $m = 16000$
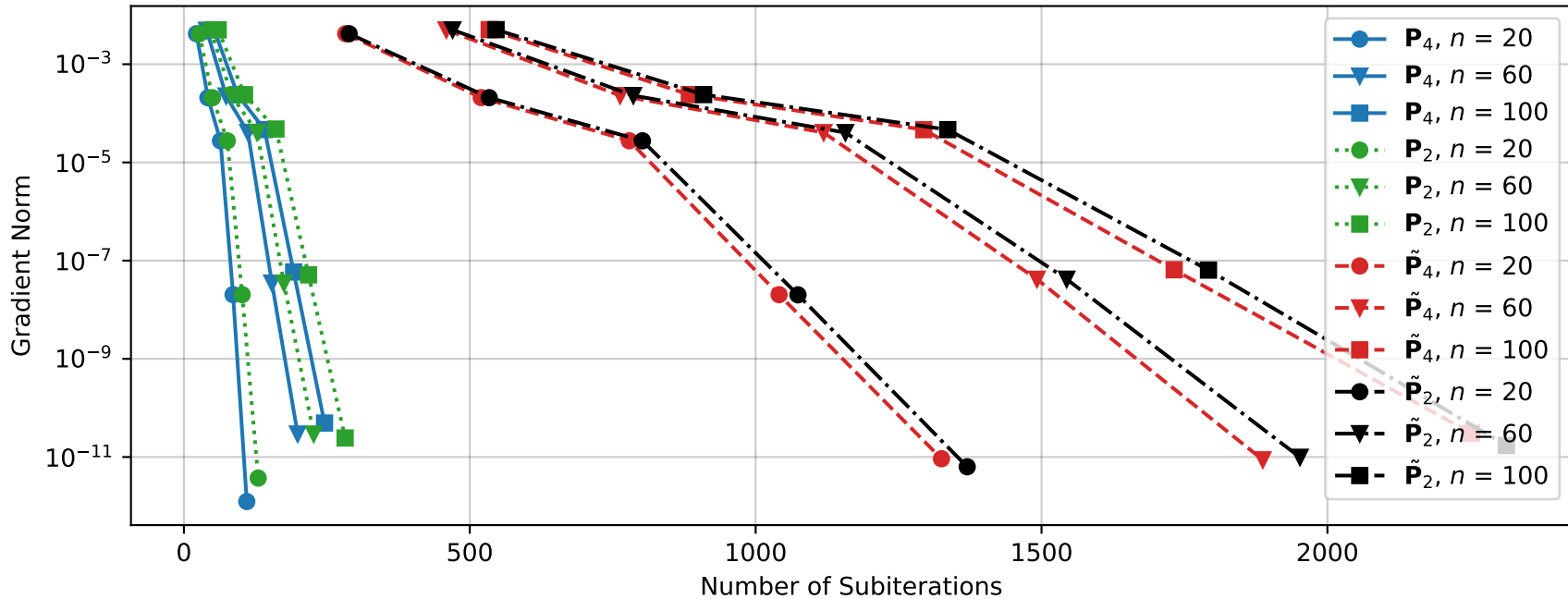
Full-space Gradient vs Subiterations

Full-space Design Cycles vs Control Variables

Legend:
- FS $\mathbf{P}_4$, $m = 4000$
- FS $\mathbf{P}_4$, $m = 9000$
- FS $\mathbf{P}_4$, $m = 16000$
- FS $\mathbf{P}_2$, $m = 4000$
- FS $\mathbf{P}_2$, $m = 9000$
- FS $\mathbf{P}_2$, $m = 16000$
- FS $\tilde{\mathbf{P}}_4$, $m = 4000$
- FS $\tilde{\mathbf{P}}_4$, $m = 9000$
- FS $\tilde{\mathbf{P}}_4$, $m = 16000$
- FS $\tilde{\mathbf{P}}_2$, $m = 4000$
- FS $\tilde{\mathbf{P}}_2$, $m = 9000$
- FS $\tilde{\mathbf{P}}_2$, $m = 16000$
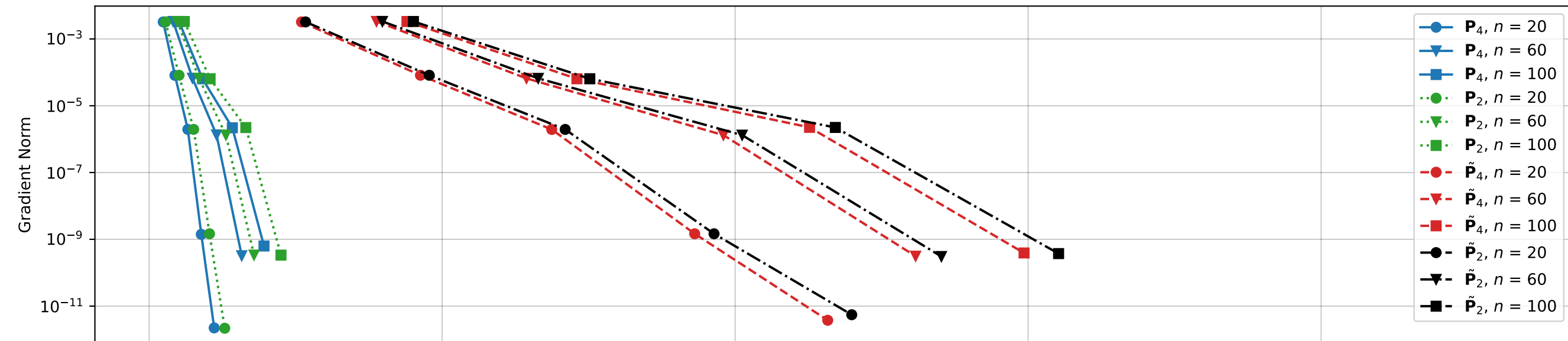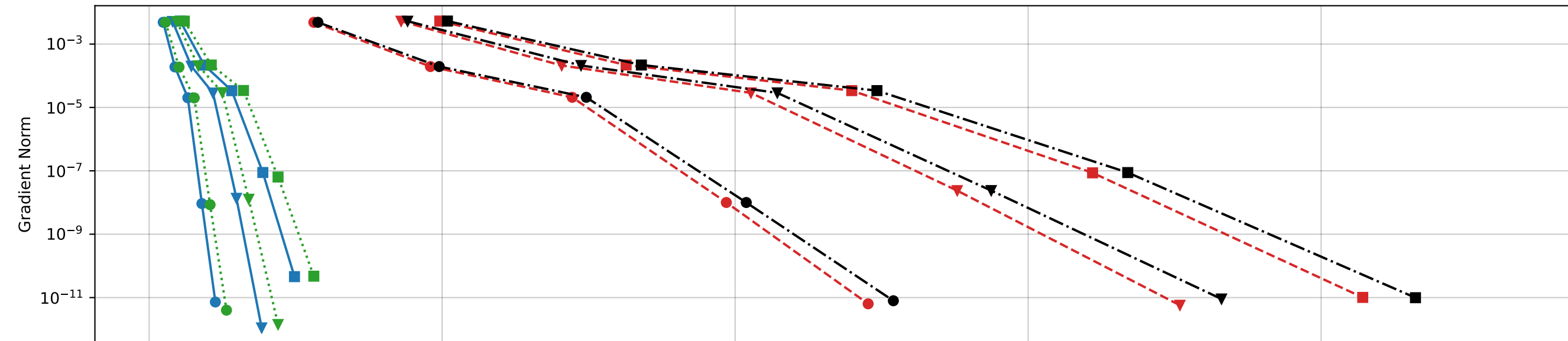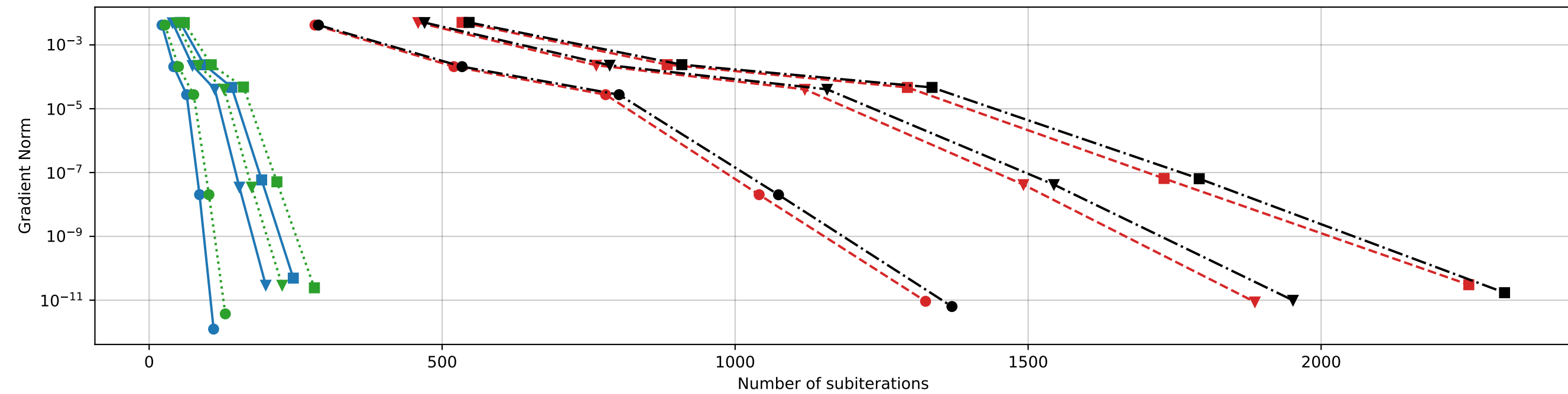
Number of Design Cycles to Convergence

Number of Control Variables n

Work Units vs Control Variables

Legend:
- FS $\mathbf{P}_4$, $m = 4000$
- FS $\mathbf{P}_4$, $m = 9000$
- FS $\mathbf{P}_4$, $m = 16000$
- FS $\mathbf{P}_2$, $m = 4000$
- FS $\mathbf{P}_2$, $m = 9000$
- FS $\mathbf{P}_2$, $m = 16000$
- FS $\tilde{\mathbf{P}}_4$, $m = 4000$
- FS $\tilde{\mathbf{P}}_4$, $m = 9000$
- FS $\tilde{\mathbf{P}}_4$, $m = 16000$
- FS $\tilde{\mathbf{P}}_2$, $m = 4000$
- FS $\tilde{\mathbf{P}}_2$, $m = 9000$
- FS $\tilde{\mathbf{P}}_2$, $m = 16000$

X-axis: Number of Control Variables n

Y-axis: Work Units to Convergence

Total Subiterations vs Control Variables

Legend:
- FS $\mathbf{P}_4$, $m = 4000$
- FS $\mathbf{P}_4$, $m = 9000$
- FS $\mathbf{P}_4$, $m = 16000$
- FS $\mathbf{P}_2$, $m = 4000$
- FS $\mathbf{P}_2$, $m = 9000$
- FS $\mathbf{P}_2$, $m = 16000$
- FS $\tilde{\mathbf{P}}_4$, $m = 4000$
- FS $\tilde{\mathbf{P}}_4$, $m = 9000$
- FS $\tilde{\mathbf{P}}_4$, $m = 16000$
- FS $\tilde{\mathbf{P}}_2$, $m = 4000$
- FS $\tilde{\mathbf{P}}_2$, $m = 9000$
- FS $\tilde{\mathbf{P}}_2$, $m = 16000$
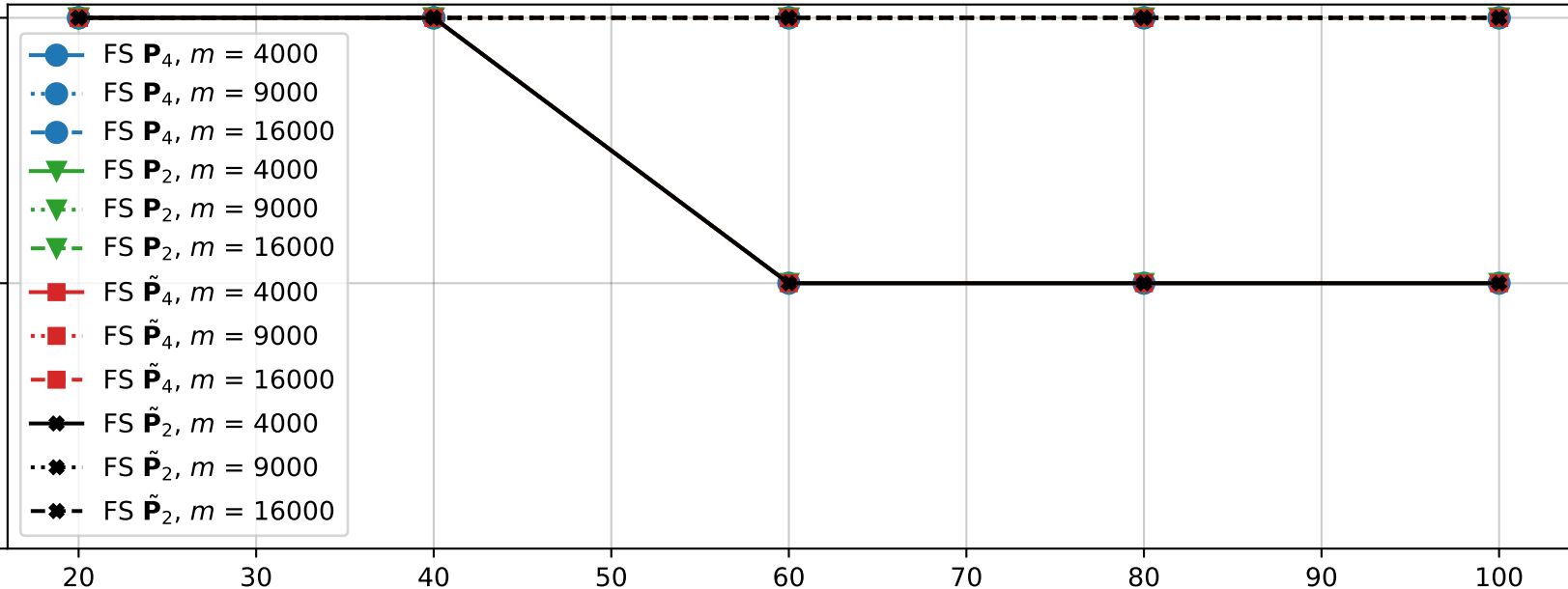
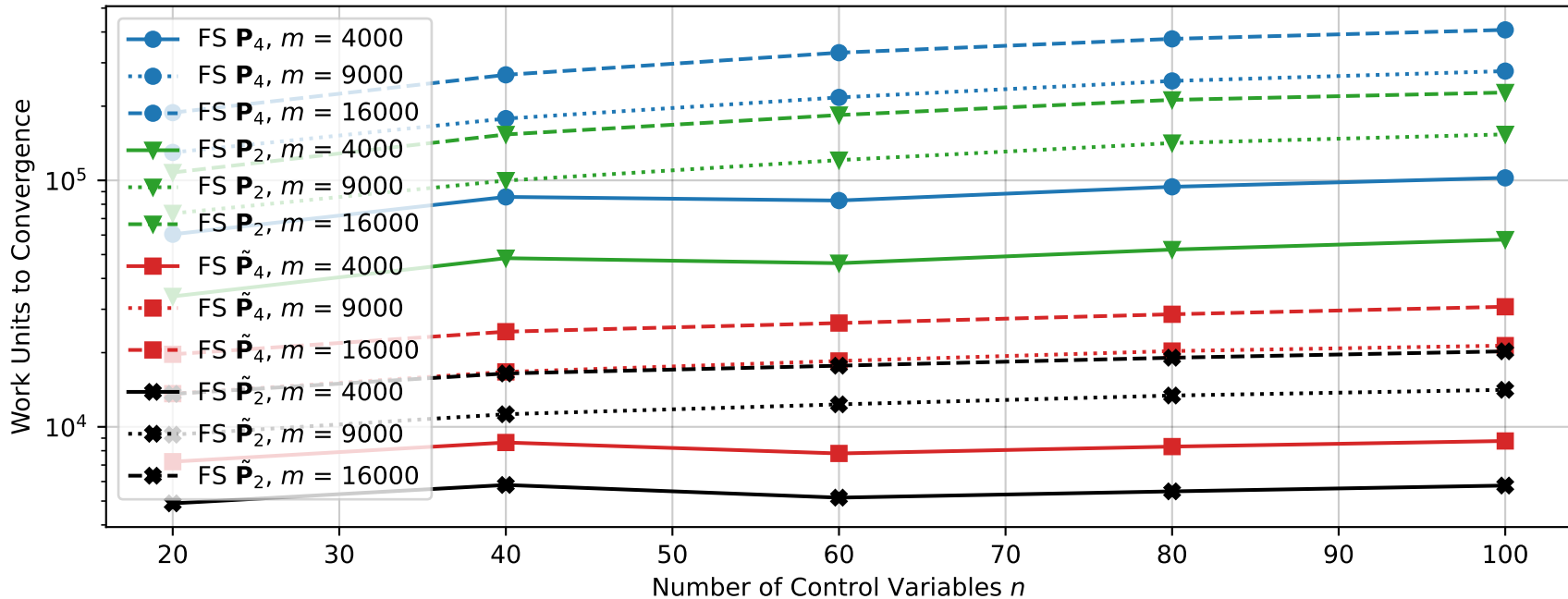X-axis: Number of Control Variables n

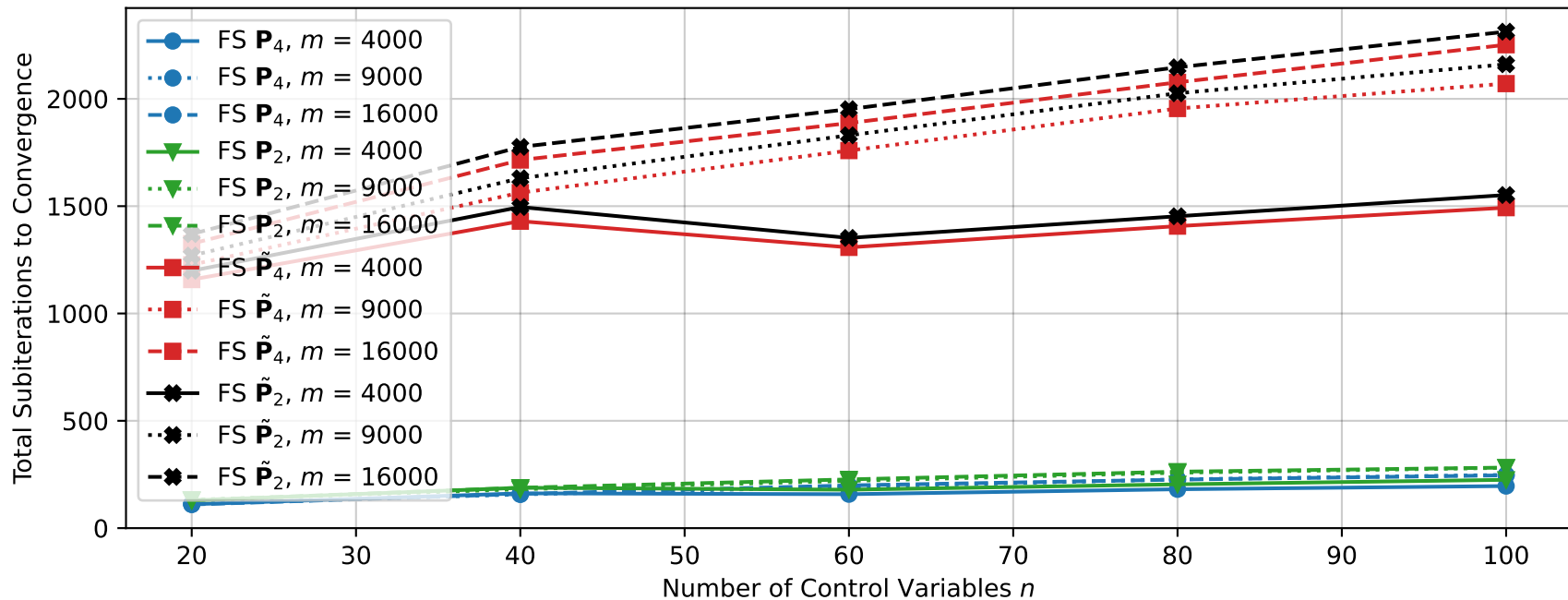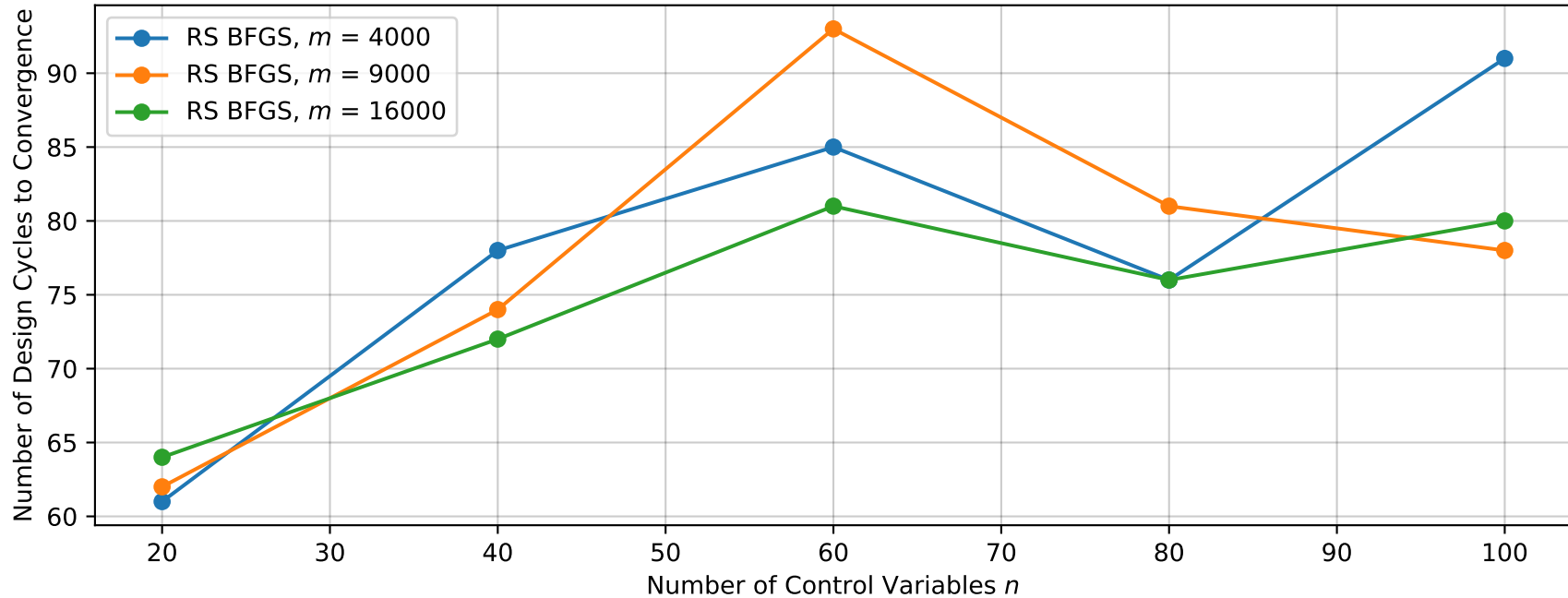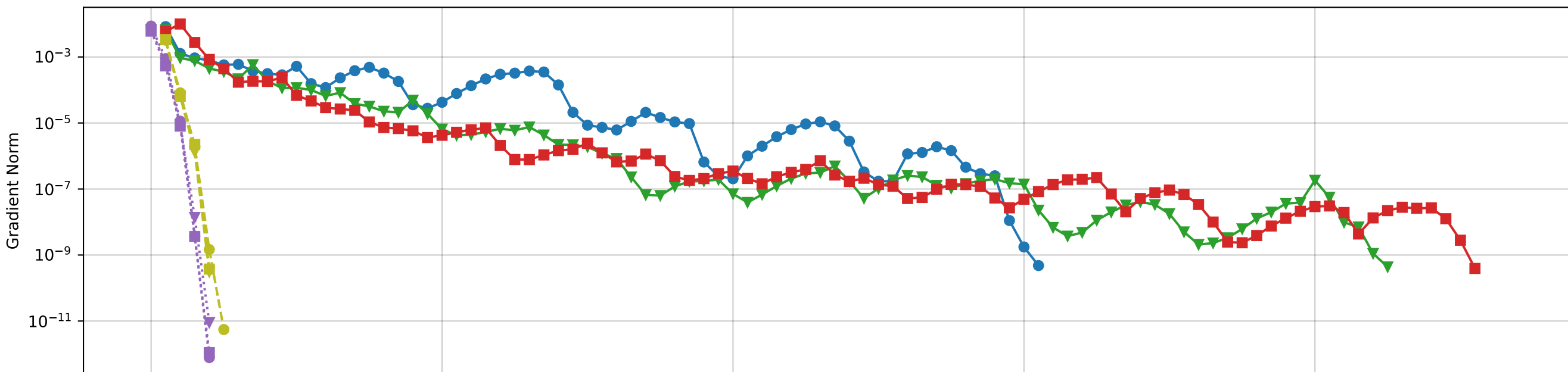Y-axis: Total Subiterations to Convergence

Work Units vs Control Variables
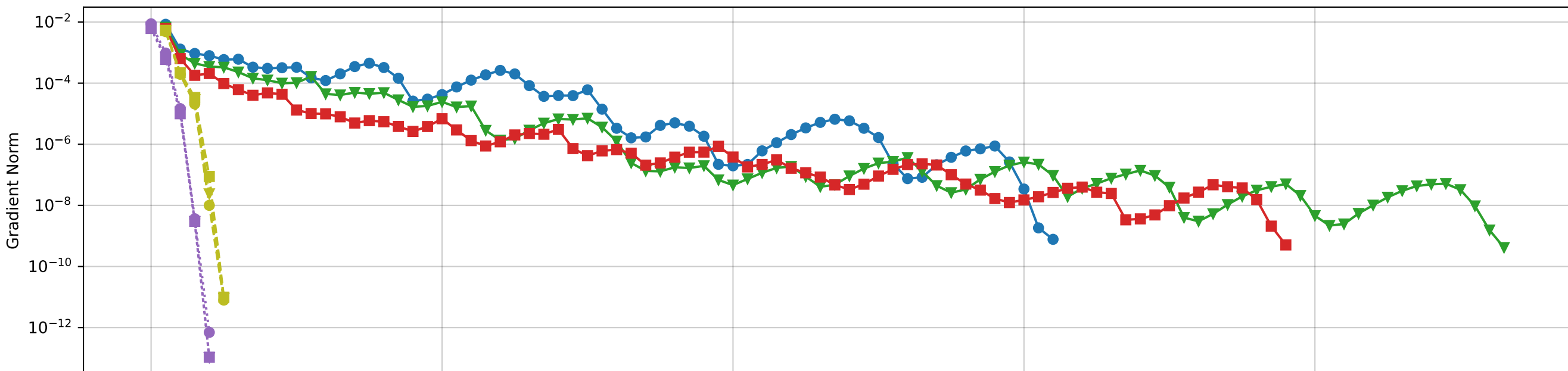
Reduced-space Design Cycles vs Control Variables

Reduced-space Gradient vs Design Cycles
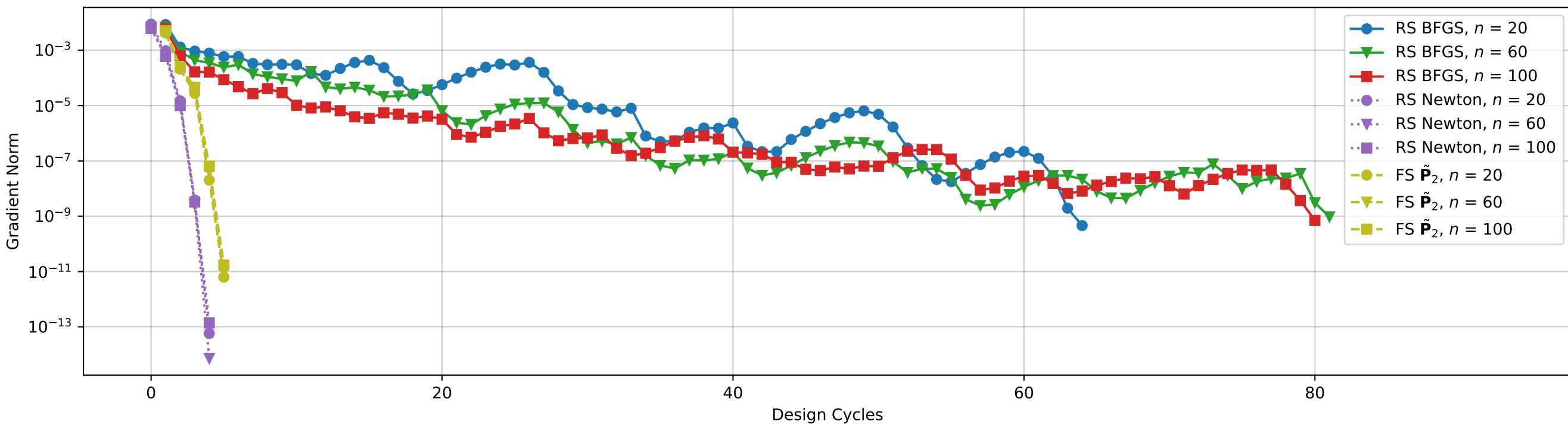
Work Units vs Control Variables
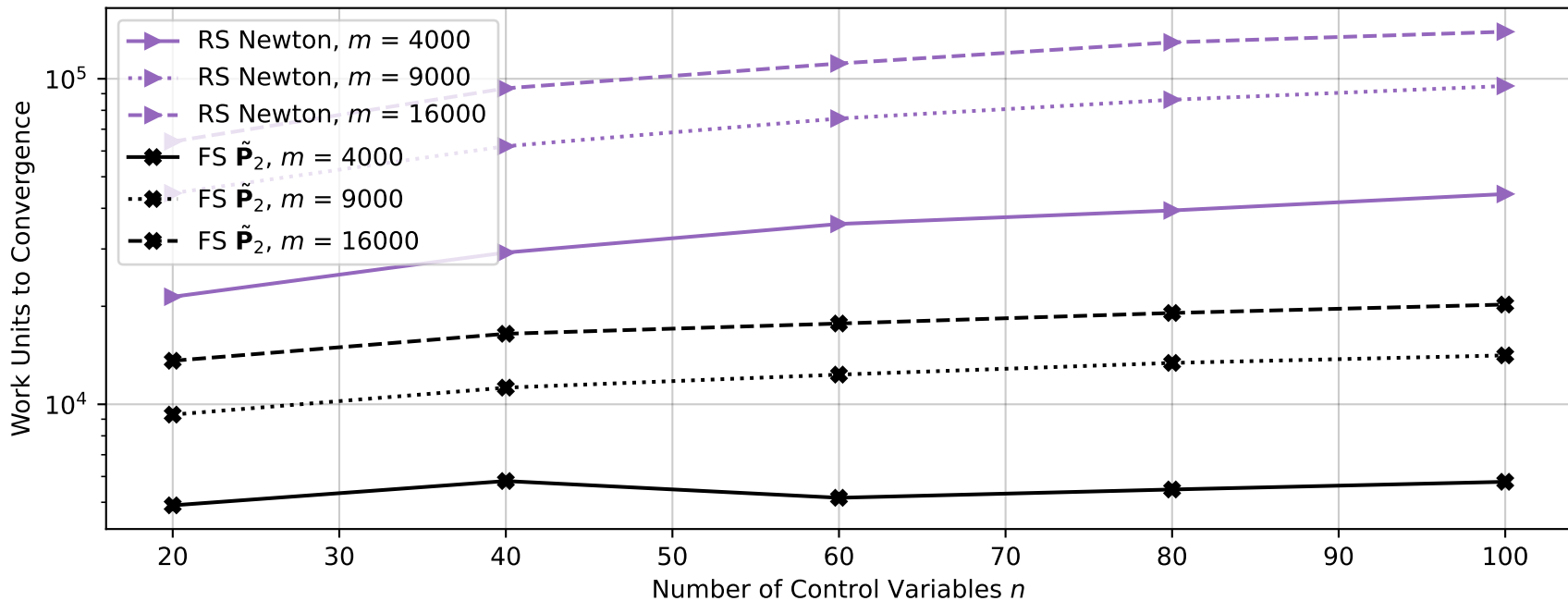
Work Units vs State Variables

Legend:
- RS Newton, $n = 20$
- RS Newton, $n = 40$
- RS Newton, $n = 60$
- RS Newton, $n = 80$
- RS Newton, $n = 100$
- FS $\tilde{\mathbf{P}}_2$, $n = 20$
- FS $\tilde{\mathbf{P}}_2$, $n = 40$
- FS $\tilde{\mathbf{P}}_2$, $n = 60$
- FS $\tilde{\mathbf{P}}_2$, $n = 80$
- FS $\tilde{\mathbf{P}}_2$, $n = 100$

Y-axis: Work Units to Convergence

X-axis: Number of State Variables m
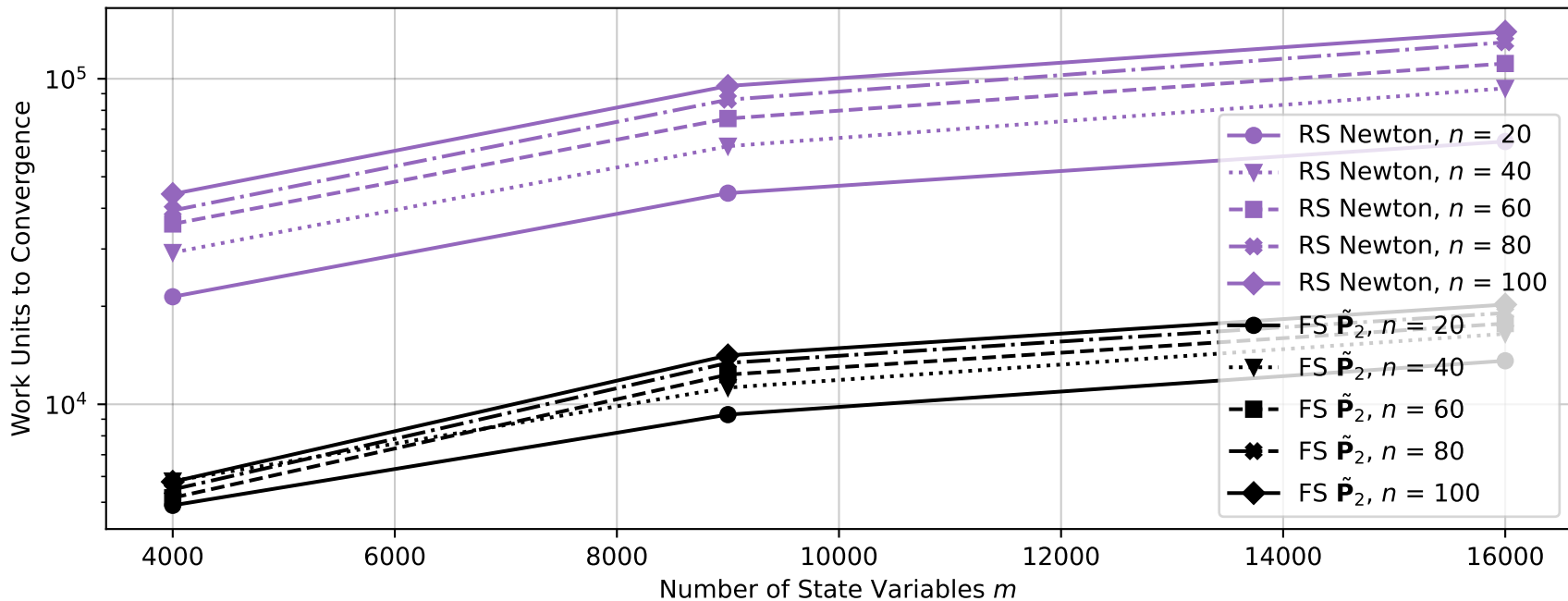
Gradient Norm vs Design Cycles m = 4000

Legend:
- RS BFGS, $n = 20$
- RS BFGS, $n = 60$
- RS BFGS, $n = 100$
- RS Newton, $n = 20$
- RS Newton, $n = 60$
- RS Newton, $n = 100$
- FS $\tilde{\mathbf{P}}_2$, $n = 20$
- FS $\tilde{\mathbf{P}}_2$, $n = 60$
- FS $\tilde{\mathbf{P}}_2$, $n = 100$

X-axis: Design Cycles

Y-axis: Gradient Norm