High Temperature Receiver Design and Analysis Package (srlife)

1. Impact
Designing durable metallic receivers for prolonged operation above 800°C is challenging and represents a major risk in implementing next-gen CSP systems. Better methods for estimating receiver life and computer-aided design optimization could reduce costs and risk.

2. Project Goal
Provide system designers with a rapid (<1 minute per design), accurate means to estimate the structural life of a receiver that can be embedded into an existing software stack and used to optimize/tune receiver designs.

3. Method(s)
Leverage existing software (Heliosim, SolarPILOT, NEML, etc.) and existing material data, where available. Provide a validated, open-source software tool.

4. Outcome(s)

5. Conclusion/Risks
Approximate analysis with good heuristics is nearly as accurate as full 3D simulation but two orders of magnitude faster. Predictions are only as good as the available material data, which is sparse for some materials. Life estimates can be very sensitive to metal temperatures – reducing by 10°C can increase receiver life by years!

6. Team
ANL: modeling and tool development
INL: A282 test data
ANU: system developer feedback and testing

Figure 1. Computational heuristics, like dimensionality reduction here, enables rapid life estimation meeting project goals

Figure 2. Alloy 740H receiver life prediction versus outlet temperature