**6.1** A visualization of the design process as the selection of an element from the design space $\mathcal{D}$ that is in a region of the output space $O$ that meets the requirements. 210

**6.2** A single design set $D$, the solution $f$ of its set $E$ of governing equations, and the inverse solution $f^{-1}$. The local optimal design $d^* = f^{-1}(\boldsymbol{y}^*)$. 214

**6.3** Sketch of the extruder design. 216

**6.4** The constrained loss function $L(d)$ versus a single adjustable, the thermal resistance $R_T$. 220

## D.2 List of Tables


**3.1** JSON to Python reading conversion. 78

**3.2** Python to JSON writing conversion. 78

**4.1** Elementary mathematical functions in SymPy. 107

## Bibliography


Abelson, Hal, and Gerald Jay Sussman. 2016. *Structure and Interpretation of Computer Programs.* 2nd ed. MIT Press (orig. 1996). https://engcom.org/5n.

Carvill, James. 1994. *Mechanical Engineer's Data Handbook.* Butterworth-Heinemann.

Cross, Nigel. 2021. *Engineering Design Methods: Strategies for Product Design, 5th Edition.* 5th ed. Wiley. http://gen.lib.rus.ec/book/index.php?md5=988D6046DBEE3E1452E2F099079B445E.

Filik, Ruth, Alexandra Ţurcan, Christina Ralph-Nearman, and Alain Pitiot. 2019. "What is the difference between irony and sarcasm? An fMRI study." [in eng]. *Cortex* 115 (June): 112–122. https://doi.org/10.1016/j.cortex.2019.01.025. https://engcom.org/e8.

Gilens, Martin, and Benjamin I. Page. 2014. "Testing Theories of American Politics: Elites, Interest Groups, and Average Citizens." *Perspectives on Politics* 12 (3): 564–581. https://doi.org/10.1017/S1537592714001595.

Gonzalez, Ryan, Philip House, Ivan Levkivskyi, et al. 2024. *PEP 526 – Syntax for Variable Annotations,* February (orig. 2016). https://engcom.org/9x.

Google. 2024. *Google Python Style Guide,* February. https://engcom.org/ne.

Harris, Charles R., K. Jarrod Millman, Stéfan J. van der Walt, et al. 2020. "Array Programming with NumPy." *Nature* 585, no. 7825 (September): 357–362. https://doi.org/10.1038/s41586-020-2649-2. https://doi.org/10.1038/s41586-020-2649-2.

Hunt, A., and D. Thomas. 1999. *The Pragmatic Programmer: From Journeyman to Master.* Pearson Education.

Hunter, J. D. 2007. "Matplotlib: A 2D graphics environment." *Computing in Science & Engineering* 9 (3): 90–95. https://doi.org/10.1109/MCSE.2007.55.

Johnston, Nathaniel, and Dave Greene. 2022. *Conway's Game of Life: Mathematics and Construction.* Self-published. https://doi.org/10.5281/zenodo.6097284.

Kreyszig, E. 2010. *Advanced Engineering Mathematics.* 10th ed. John Wiley & Sons.

Langa, Łukasz, and contributors to Black. 2024. *Black: The Uncompromising Python Code Formatter,* February. https://engcom.org/8n.

NASA. 2002. *NACA High Speed Flight Station "Computer Room",* June (orig. 1949). https://engcom.org/mz.

NumPy Developers. 2024a. *NumPy Reference,* February (orig. 2022). https://engcom.org/u5.

NumPy Developers. 2024b. *NumPy User Guide*, February (orig. 2022). https://engcom.org/5y.

NumPy Developers. 2024c. *NumPy: The Absolute Basics for Beginners*, February (orig. 2022). https://engcom.org/3l.

Python Community. 2024a. *Python 3.X Documentation*, January. https://engcom.org/n3.

Python Community. 2024b. *Python Package Index*, January. https://engcom.org/e0.

Python Community. 2024c. *Python Packaging User Guide*, January. https://engcom.org/w9.

Rossum, Guido van, Jukka Lehtosalo, and Łukasz Langa. 2024. *PEP 484 – Type Hints*, February (orig. 2014). https://engcom.org/z9.

Rossum, Guido van, Barry Warsaw, and Alyssa Coghlan. 2024. *PEP 8 – Style Guide for Python Code*, February (orig. 2001). https://engcom.org/3z.

SymPy Development Team. 2023a. *Advanced Expression Manipulation*, May. https://engcom.org/95.

SymPy Development Team. 2023b. *Core [SymPy Documentation]*, May. https://engcom.org/92.

SymPy Development Team. 2023c. *Simplification*, May. https://engcom.org/14.

SymPy Development Team. 2023d. *Writing Custom Functions*, May. https://engcom.org/3c.

Tufte, Edward R. 2001. *The Visual Display of Quantitative Information*. 2nd ed. Graphics Press.

Yasskin, Jeffrey. 2024. *PEP 3141 – A Type Hierarchy for Numbers*, February (orig. 2007). https://engcom.org/41.

## Contributors

**Associate Professor Rico A. R. Picone**
Department of Mechanical Engineering
Saint Martin's University
Lacey, Washington, USA