

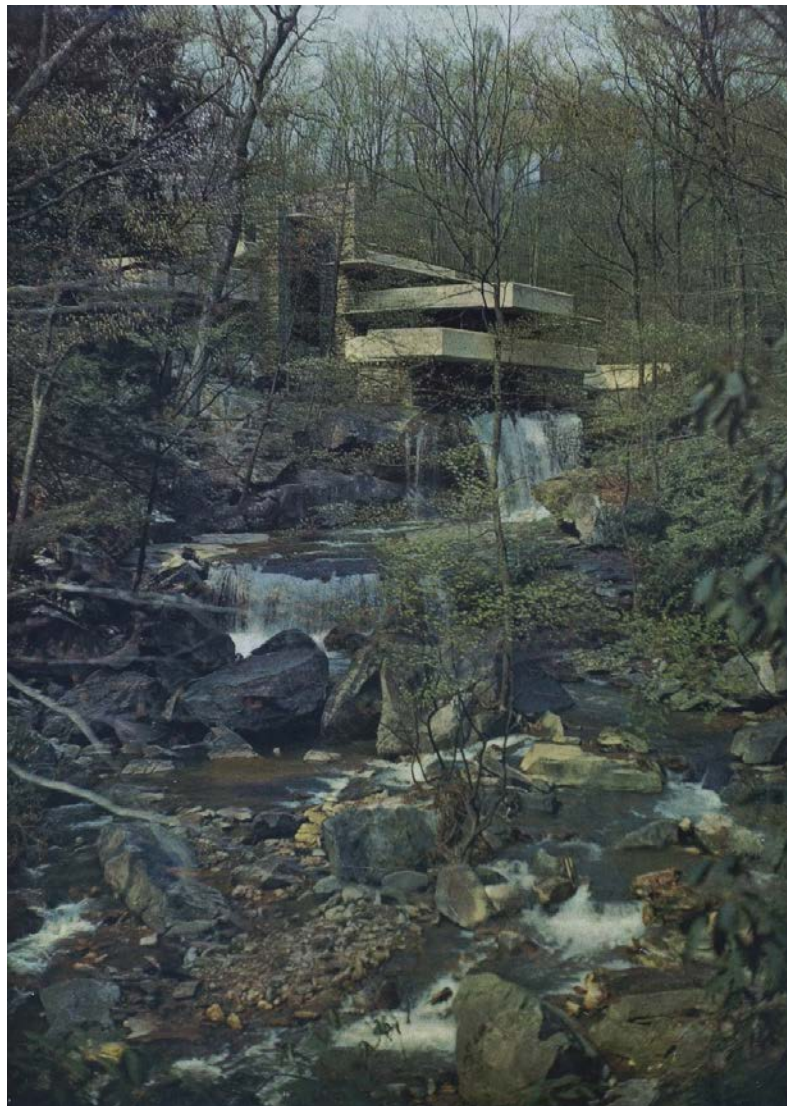
# Measuring Fallingwater:

## **A computational fractal analysis of Wright's Kaufman House in the context of his theories and domestic architecture.**

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*Figure 1.1 "Fallingwater in Springtime" (Zevi 1965: 29)*

### **Statement of Originality**

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision.

The thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968.

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*I hereby certify that the work embodied in this thesis contains published papers/scholarly work of which I am a joint author. I have included below, as part of the thesis a written statement, endorsed by my supervisor, attesting to my contribution to the joint publications/scholarly work.*

Between 2009 and 2016, Josephine Vaughan (the candidate) and Professor Michael J. Ostwald (primary supervisor), jointly published 25 papers and a co-authored monograph, developing the basic analytical method and some of the arguments used in this dissertation. Sections of these jointly authored publications form the basis for several chapters in this dissertation, although all have been modified and revised for this purpose.

In accordance with the University of Newcastle policy, this statement is to confirm that the sections of these past publications which are used in this dissertation are those for which the candidate led the primary authoring and/or intellectual development. Notwithstanding this general statement, Chapter 1 provides a complete list of the sources for any sections or ideas, fully referenced to the original authorship and place of publication. Furthermore, for Hypothesis 1, the method was jointly developed, and the results were solely produced and analyzed by the candidate. For Hypothesis 2, the candidate solely developed the method, the results and completed the subsequent analysis.

Josephine Vaughan (candidate)

Professor Michael J. Ostwald (supervisor)

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## Abstract

Sited above a waterfall on Bear Run stream, in a wooded gulley in Mill Run, Pennsylvania, the Kaufman house, or *Fallingwater* as it is commonly known, is one of the most famous buildings in the world. This house, which Frank Lloyd Wright commenced designing in 1934, has been the subject of enduring scholarly analysis and speculation for many reasons, two of which are the subject of this dissertation. The first is associated with the positioning of the design in Wright's larger body of work. Across 70 years of his architectural practice, most of Wright's domestic work can be categorised into three distinct stylistic periods—the Prairie, Textile-block and Usonian. Compared to the houses that belong to those three periods, *Fallingwater* appears to defy such a simple classification and is typically regarded as representing a break from Wright's usual approach to creating domestic architecture. A second, and more famous argument about *Fallingwater*, is that it is the finest example of one of Wright's key design propositions, Organic architecture. In particular, Wright's *Fallingwater* allegedly exhibits clear parallels between its form and that of the surrounding natural landscape. Both theories about *Fallingwater*—that it is different from his other designs and that it is visually similar to its setting—seem to be widely accepted by scholars, although there is relatively little quantitative evidence in support of either argument. These theories are reframed in the present dissertation as two hypotheses.

Using fractal dimension analysis, a computational method that mathematically measures the characteristic visual complexity of an object, this dissertation tests two hypotheses about the visual properties of Frank Lloyd Wright's *Fallingwater*. These hypotheses are only used to define the testable goals of the dissertation, as due to the many variables in the way architectural historians and theorists develop arguments, the hypotheses cannot be framed in a pure scientific sense.

To test Hypothesis 1, the computational method is applied to fifteen houses from three of Wright's well-documented domestic design periods, and the results are compared with measures that are derived from *Fallingwater*. Through this process a mathematical determination can be made about the relationship between the formal expressions of *Fallingwater* and that of Wright's other domestic architecture. To test Hypothesis 2, twenty analogues of the natural landscape surrounding *Fallingwater* are measured using the same computational method, and the results compared to the broader formal properties of the house. Such a computational and mathematical analysis has never before been undertaken of *Fallingwater* or its surrounding landscape.

The dissertation concludes by providing an assessment of the two hypotheses, and through this process demonstrates the usefulness of fractal analysis in the interpretation of architecture, and the natural environment. The numerical results for Hypothesis 1 do not have a high enough percentage difference to suggest that *Fallingwater* is atypical of his houses, confirming that Hypothesis 1 is false. Thus the outcome does not support the general scholarly consensus that *Fallingwater* is different to Wright's other domestic works. The results for Hypothesis 2 found a mixed level of similarity in characteristic complexity between *Fallingwater* and its natural setting. However, the background to this hypothesis suggests that the results should be convincingly positive and while some of the results are supportive, this was not the dominant outcome and thus Hypothesis 2 could potentially be considered disproved. This second outcome does not confirm the general view that *Fallingwater* is visually similar to its surrounding landscape.

## Prelude



The approach to *Fallingwater* is famous for its drama and the immersion in nature it requires (fig. 1.2). At the end of a long walk through the forests of Bear Run Nature Reserve, the visitor finally reaches their destination. It is a real moment of revelation, as the valley opens out along the Bear Run watercourse and *Fallingwater* is revealed in its majesty, like something that has grown out of the site. This is the house that Wright commenced designing for the Kaufmann family in 1934.



Its appearance would have been unlike that of any other building of the era; its bulk both poised above and stacked on the site (Maddex 1998). Broad concrete horizontal outdoor spaces are layered around its core, projecting beyond the rising walls of rough-cut stone which enclose small private rooms. Geometrical patterns of dark red window frames hold glistening glass, creating a space somewhere between inside and outside, reflecting the dampness of the forest.



Figure 1.2 Approaching Fallingwater  
(Photographs by the author)

This is a house that seemingly evokes the mystery and power of its setting. The approach through the landscape to *Fallingwater* can be considered as a demonstration of a key principle of Wright's architectural strategy, to create a clear relationship between a building and its setting. According to historian Gwendolyn Wright, *Fallingwater* exploits 'the startling dramatic potential of a precarious slash of rock that extended over a waterfall, epitomizing the interplay of daring technologies and theatrical gestures' (1994: 85).