Wood as Inquiry

Nina Lutz

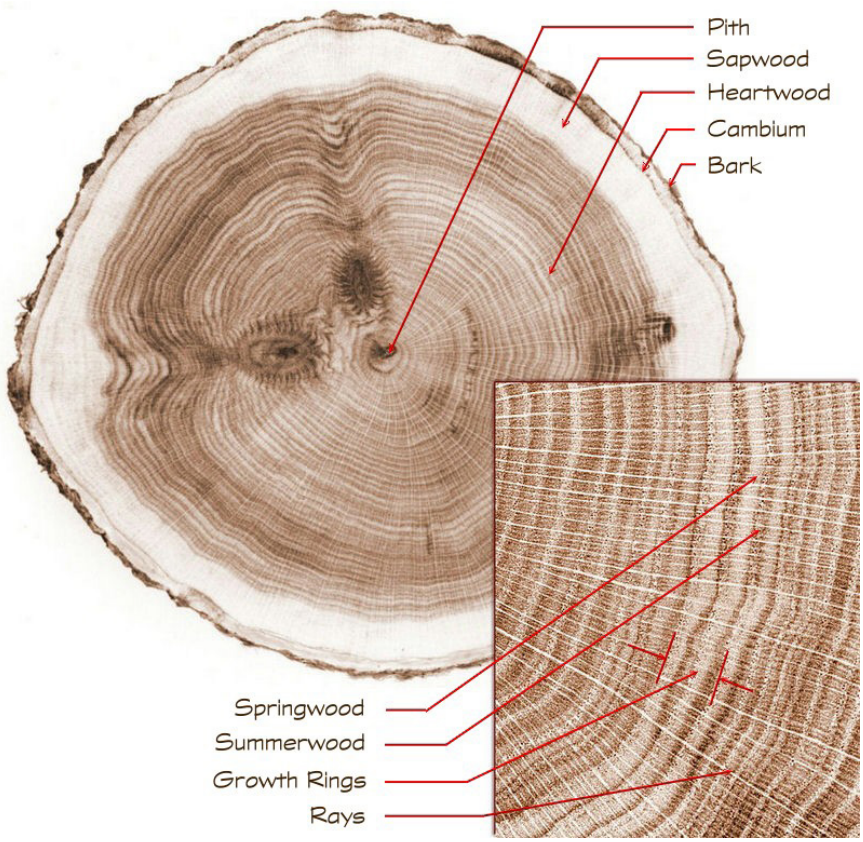
02.15.2018

N. Lutz | Wood as Inquiry

Wood is a fundamental material in both natural and man made systems. For centuries trees have grown and weathered seasons and differentiation. And in this time man has sought to domesticate wood in many forms. These variations, both natural and human, can be examined at various scales, particularly in the wood grain.

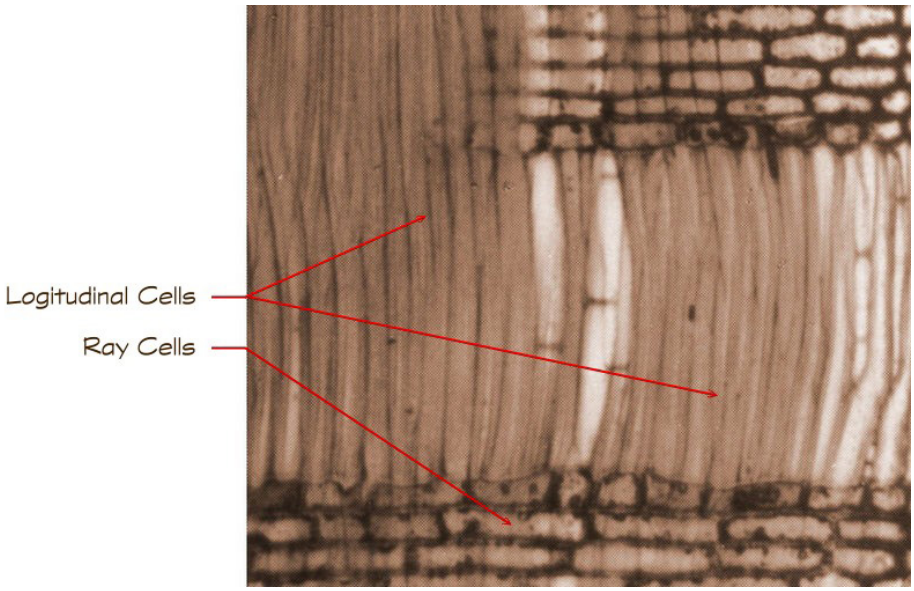
Wood grain is the longitudinal arrangement of wood fibers or the pattern resulting from this. This can be examined at various section scales — from planks to trunk cross sections — or at the cellular level. Either way the phenomena produced are fascinating and beautiful.

Image: BFO Photo



Log Level

The log is the base unit for this inquiry, in particular the cross sections of the trunk. At the center is the pith, a collection of soft dense wood and the source of the tree. Surrounding it is heartwood, which is dead cells that support the tree. The sapwood precedes that and carries the food for the tree. Outside of the sapwood is the cambium, a thin layer of living cells. They're the active wood manufacturing bark and collecting nutrients. The cambium goes through the growing season and eventually becomes this sapwood as it grows from spring to darker summer wood, with its dormancy in winter becoming a growth ring.



Cellular Level

Wood grain forms from a cellular level, in particular two cells; longitudinal and ray cells. The longitudinal cells are aligned with the axis of the trunk, limb, or root. Ray cells align with rays that extend out for the pith of the trunk. As wood grows, both of these cells die, leaving behind their cell walls made of cellulose fiber. The longitude cells become part of sapwood and feed the tree. Ray cells store plant sugars for energy for the tree. As sap dries and new channels form, sapwood becomes darker and hardens into hardwood. This repeats for each growth cycle.

Images: Nature of Wood

Phenomena Related to Wood Grain

1. Direction of cells
The placement and orientation of cells determines not only the grain but tree growth as a whole. More about this later.

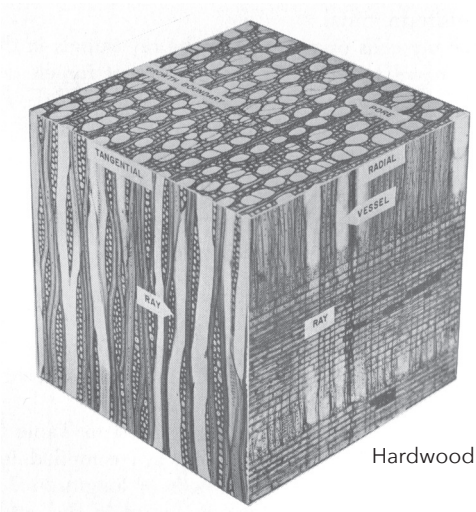
2. Growth ring placement
Growth rings develop on a seasonal cycle, but various seasons can lead to different growth and therefore different growth ring placement.

3. Surface appearance
This is fairly hand in hand with how we normally consider wood grain.

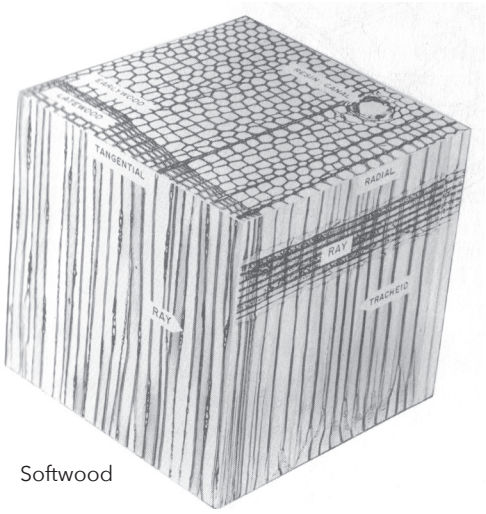
4. Plane of cut
The way the log is cut determines a lot about what the grain looks like and what type of properties that cut of wood might have.

5. Rate of growth
Rate of growth not only effects the dimensions but also the grain itself. As wood grows it goes through different cycles of cell death, resulting in various colors and grain textures.

6. Relative cell size
Again, this results in different patterns, colors, and variation potential in the grain.



Hardwood



Softwood


Image: BFO Photo

Image: BFO Photo

Types of Wood Grain

1. Straight: parallel to log
Result of species that grow straight and parallel. While it is easy to work with, there are structural concerns as all the fibers are parallel and there is no counter force.

2. Irregular: knotted and rich
A catch all term for wood grain with swirls and twists, usually a case of knots, burls, and crotch wood. Here we define crotch wood as large branch intersections.

3. Diagonal: man made grain
Result of straight grain that is sawed at an angle.

4. Spiral: twisted growth
This is a result of speculation; some trees, due to evolution in their environments grow at inclines. This requires a spiral like pattern around the trunk. While it is more difficult to work with, it is also an adaptation for water distribution as well as surviving strong winds.

5. Interlocked: directional spiral
As the tree grows, sometimes spiral grain will change direction. This direction change results in interlocked layers of wood, or interlocked grain. This change can be easily observed in quarter sawn pieces.

6. Wavy: fiber direction
This is when the wood simply grows in wavy patterns, as a result of speciation. This wood is common in various species or is often a result of the cells straining to support new limbs.

Log Level

Wood grain is also dependent on the treatment of the wood itself. Depending on how a trunk is sawed various grain patterns emerge. As seen below, every plank also has different grain classifications on its various faces.

Most planks exhibit the following types of grain:

Quarter Grain: parallel to the grain direction
End Grain: perpendicular to growth rings
Plain Grain: tangent to growth rings

Often planks of wood mostly feature long, quarter, or mixed grains. Various trees and sawing methods such as angles and patterns contribute to different plank grains and how these can mix, as well as structural properties of the actual planks.

For example, quarter grain has all parallel cells, and can break more easily. However it is easier to stain or paint.

While sawing techniques provide different grain and structure values, their main differences is how much of the log is used while making the planks.

Below are the four main sawing patterns.

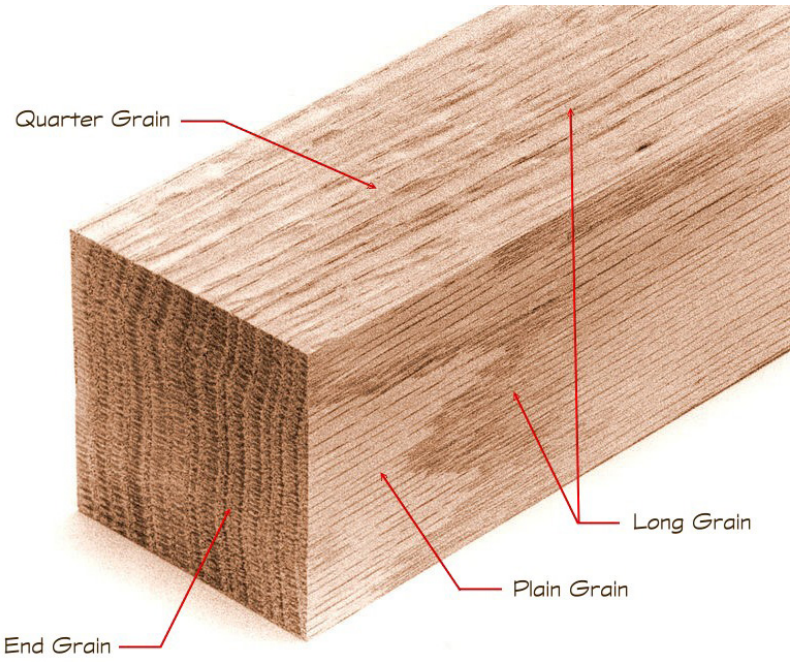


Image: Nature of Wood

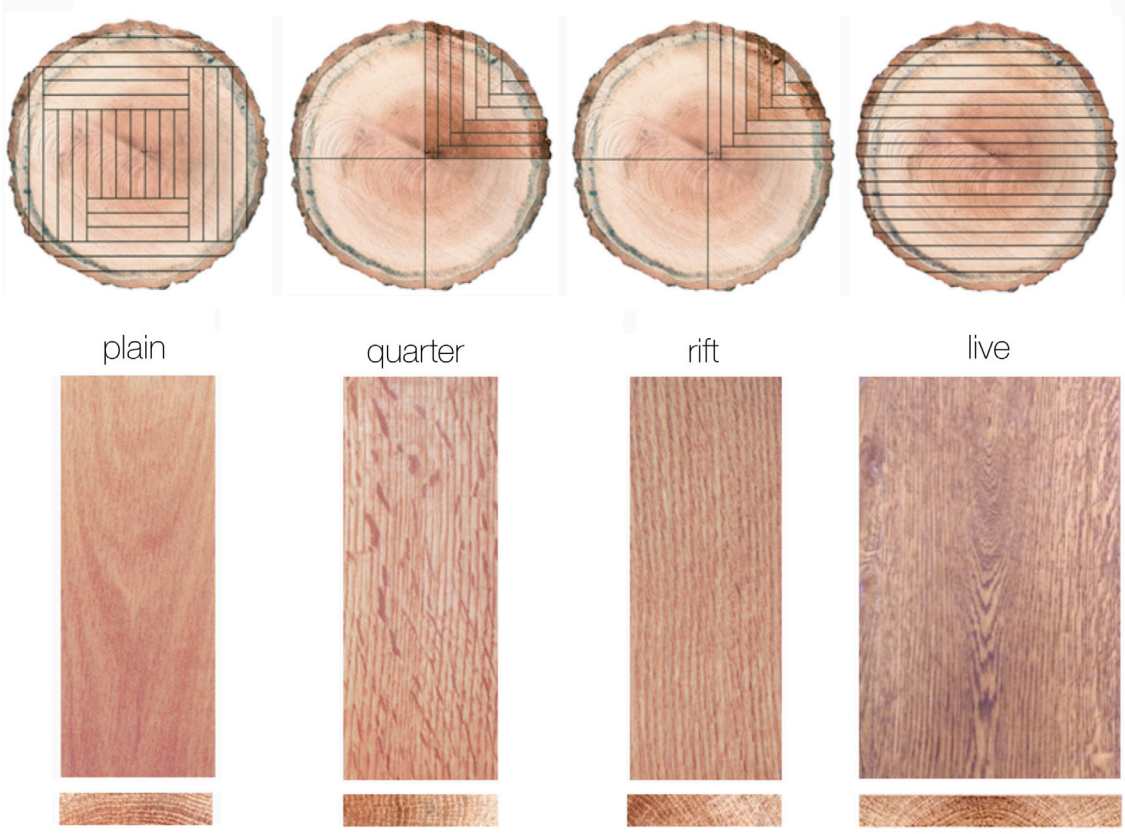


Image: Wood DataBase

Plain Saw: Most efficient use of the log

Quarter Saw: Shows quarter grain on planks

Live Saw: Much wider boards, very diverse grain.

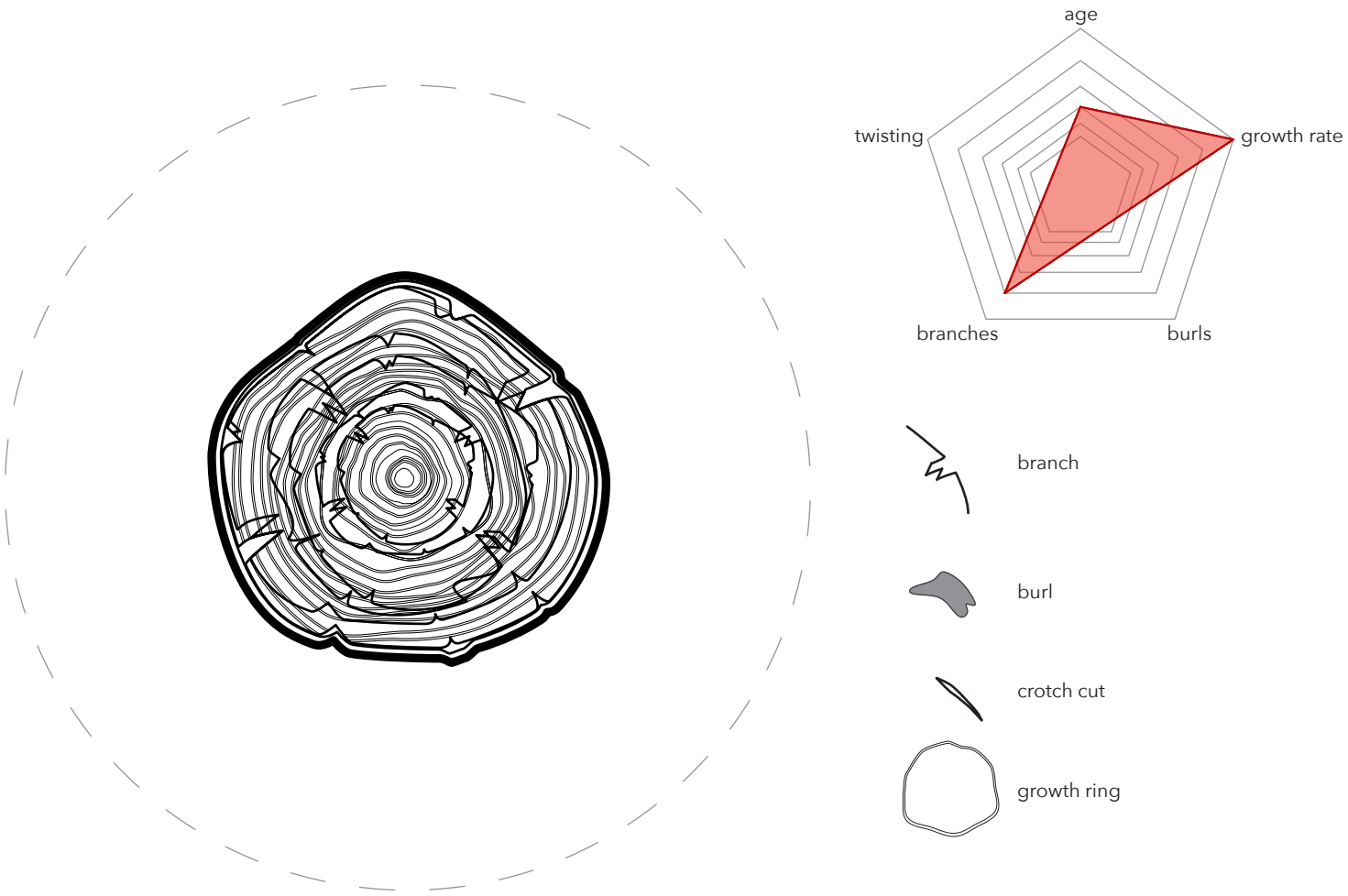
Rift Saw: Wastes the most log, but gets very linear boards and radial grain as a result.

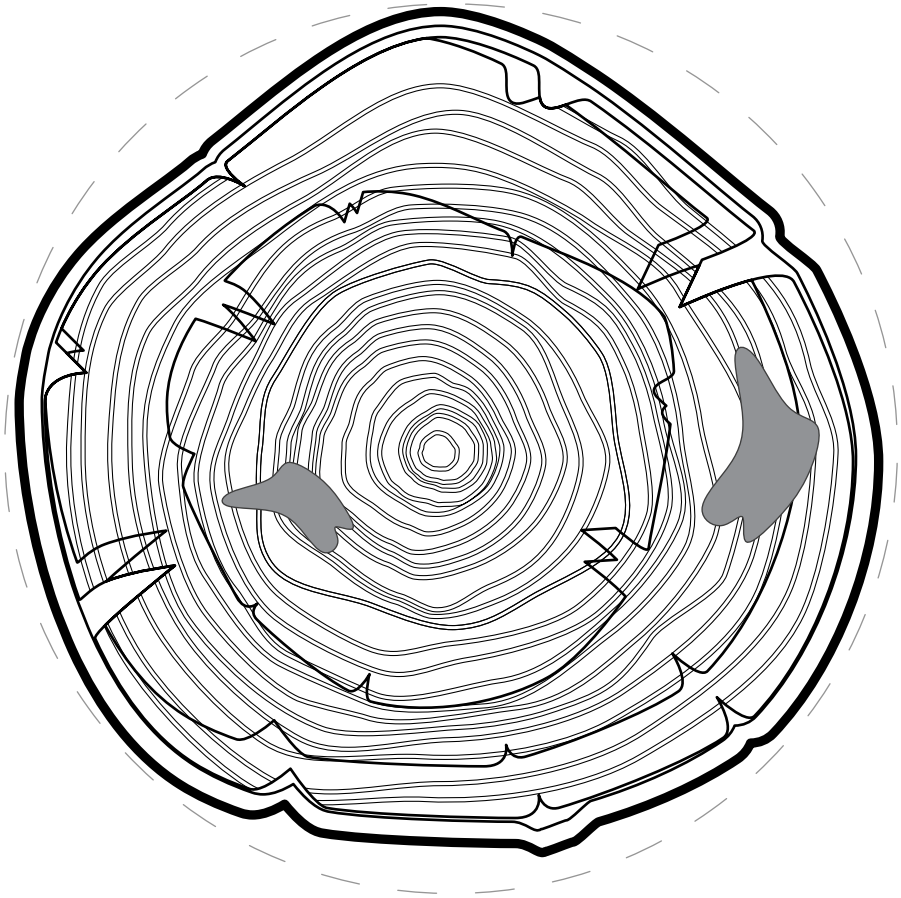
Logic Diagram

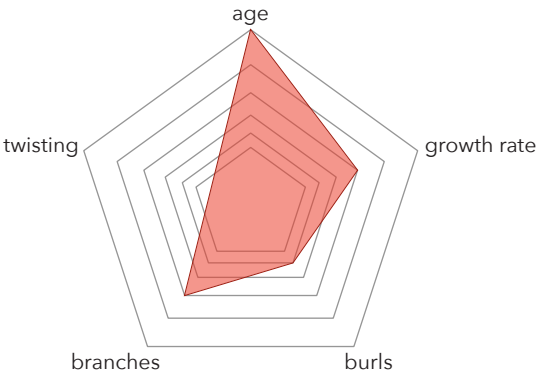
Below is a logic diagram with various factors for an example tree trunk sector.

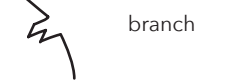
My variables and parameters to adjust are:
1. Burls
2. Branching
3. Age
4. Growth Rate
5. Twisting

By adjusting these parameters my generative sketches will show a different trunk section. Below is an example. This log has a slow growth rate (note the space between the growth rings), a high pension for branching, and medium age, burls, and cell size. This makes for a fairly uniform wood and a high chance at crotch and interlocked grain.





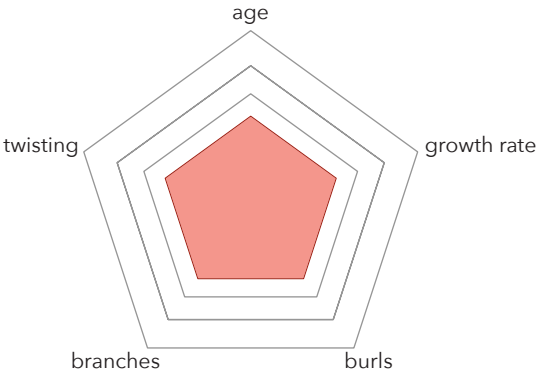



branch


burl


crotch cut

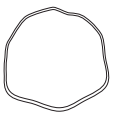

growth ring




branch


burl


crotch cut


growth ring