**Supplementary Table S1**. Definitions of the collagen fiber measurements used in the study.

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| **Collagen Feature** | **Definition** |
| Total length | Length of fiber along its full contour. |
| End-to-end length | The straight distance between the two ends of the collagen fiber. |
| Total minus end-to-end length | The simple difference between the total fiber length (along the full contour of the fiber) and the end-to-end length. This measure reflects the “curviness” of the fiber, in that fibers that are perfectly straight would have a value of zero for total minus end-to-end length as the total and end-to-end length would be identical. Fibers that have a lot of curvature or serpentine appearance would have a smaller end-to-end length relative to the total length along the contour of the fiber, and thus have a large value for total minus end-to-end length. |
| Straightness | The ratio of end-to-end length to total length. Fibers that are perfectly straight would have a value of 1 as the total and end-to-end length would be identical. Fibers that curve around completely such that one end of the fiber is close to the other end of the fiber would have a straightness value close to 0. |
| Width (µm) | The width of the collagen fiber. |
| Distance to nearest 2 fibers | The shortest distance between the centroid of the collagen fiber and the two nearest collagen fiber centroids. |
| bBox density 24x24 µm | The number of collagen fibers within a 24 µm square box centered on the fiber centroid. |
| bBox density 48x48 µm | The number of collagen fibers within a 48 µm square box centered on the fiber centroid. |
| bBox density 96x96 µm | The number of collagen fibers within a 96 µm square box centered on the fiber centroid. |
| Alignment of the nearest 4 fibers | The overall alignment of the nearest 4 fibers is determined by calculating the resultant vector length of all orientation vectors, yielding an anisotropy coefficient ranging from 0 to 1, with 1 indicating perfectly aligned fibers and 0 representing randomly oriented fibers. |
| cBox alignment 24x24 µm | The overall alignment of collagen fibers within a 24 µm square box centered on the fiber centroid is determined by calculating the resultant vector length of all orientation vectors, yielding an anisotropy coefficient ranging from 0 to 1, with 1 indicating perfectly aligned fibers and 0 representing randomly oriented fibers |
| Distance to tumor/stromal boundary (µm) | The shortest distance between the collagen fiber and the tumor/stromal boundary. |
| Angle relative to tumor/stromal boundary (°) | The angle of a line extending from the end of the collagen fiber in relation to a straight line tangent drawn at the nearest tumor/stromal boundary. |
| Composite Factor 1 | A linear combination of the above collagen features that has a strong positive dependency on “Box density 24x24 µm” and a strong negative dependency on “Box alignment 24x24 µm”. |
| Composite Factor 2 | A linear combination of the above collagen features that has strong positive dependencies on “Box density 96x96 µm” and “ Distance to tumor/stromal boundary “. |
| Composite Factor 3 | A linear combination of the above collagen features that has a strong positive dependency on “Total minus end-to-end fiber length ” and a strong negative dependency on “Straightness”. |
| Composite Factor 4 | A linear combination of the above collagen features that has a strong positive dependency on “Alignment of the nearest four fibers” and a strong negative dependency on “Angle to the tumor/stromal boundary”. |
| Composite Factor 5 | A linear combination of the above collagen features that has strong positive dependencies on “Total length” and “Width“. |