Annual Ring Orientation, Speed of Sound and Multiple Piece Oud Soundboards.

The acoustic tests on three cross grain samples of Sitka spruce reported in Comm. 1963 indicate that the measured speed of sound across sample G (annual rings at 45°) was about 65% of that measured across sample E (annual rings vertical or 0°). In other words a soundboard with the annual rings perpendicular to the face - all else being equal - is significantly stiffer across its width than one with the grain sloping at 45° - the stiffness reducing with increasing grain deviation from vertical. Grain orientation from 0° to 45° covers the commercial definition of 'quarter sawn' material.
No tests were undertaken to measure stiffness for grain orientation in the range 45° to 90° (i.e. tangential).

Martin Schleske in his research paper "Speed of Sound and Damping of Spruce in Relation to the Direction of Grains and Rays" (Note 1) includes test data measuring the influence of annual ring orientation on measured speed of sound. It has, therefore, been possible to tentatively confirm that the results of the tests reported in Comm. 1963 are quantitatively 'in the same ballpark' as the Schleske data.
Fig 1 is an adaptation of Schleske's histogram chart (Fig5) modified to represent the percentage variation of speed of sound relative to annual ring orientation. The 'bathtub' shaped curve shows that speed of sound (S.O.S.) – from a maximum value at a grain angle of 0° - reduces to a minimum value at a grain angle of about 55° (to about 65% of maximum S.O.S.) but then increases as grain orientation becomes tangential at 90° (to about 35% of maximum S.O.S.)

For optimum acoustic performance popular wisdom dictates that sound board stiffness across its width should be uniform and as high as possible - consistent with low density and no longitudinal grain 'run out'. That the highest commercial grades of sound boards today are always sold as bookmatched pairs and cut perfectly on the quarter appears to support this preference. Contrary to this idea, it is said that some modern guitar makers are making successful instruments with four piece sound boards - stiff centre panels matched with lower stiffness 'wing' pieces of a softer wood species. However, presumably the same solution might be achieved by using wood of the same species perfectly quarter sawn, say, for the centre panels and 'wing' panels with grain angle deviating from vertical?

Multiple piece sound boards can often be found on even the finest of old ouds where a soundboard might be made from up to six panels – sometimes with wildly deviant longitudinal grain direction or with slab cut (tangential) grain. This must have been a deliberate choice by the Middle Eastern luthiers rather than a consequence of material shortage or size limitations - perhaps to allow maximum flexibility in 'fine tuning' a sound board for optimum performance acoustically?

Fig 2 is an example of a multiple piece (?) barbat/oud sound board – 16th C Persian miniature.
Fig 3 is the Brussels #0164 oud with multiple piece sound board. Note the slab cut panels (and pin knots!)

Notes

1) 'Speed of Sound and Damping of Spruce in Relation to the Direction of Grains and Rays', Martin Schleske, Catgut Acoustic Society, November 1990. Available on line from Google Documents, CAS_speed_of_sound.pdf

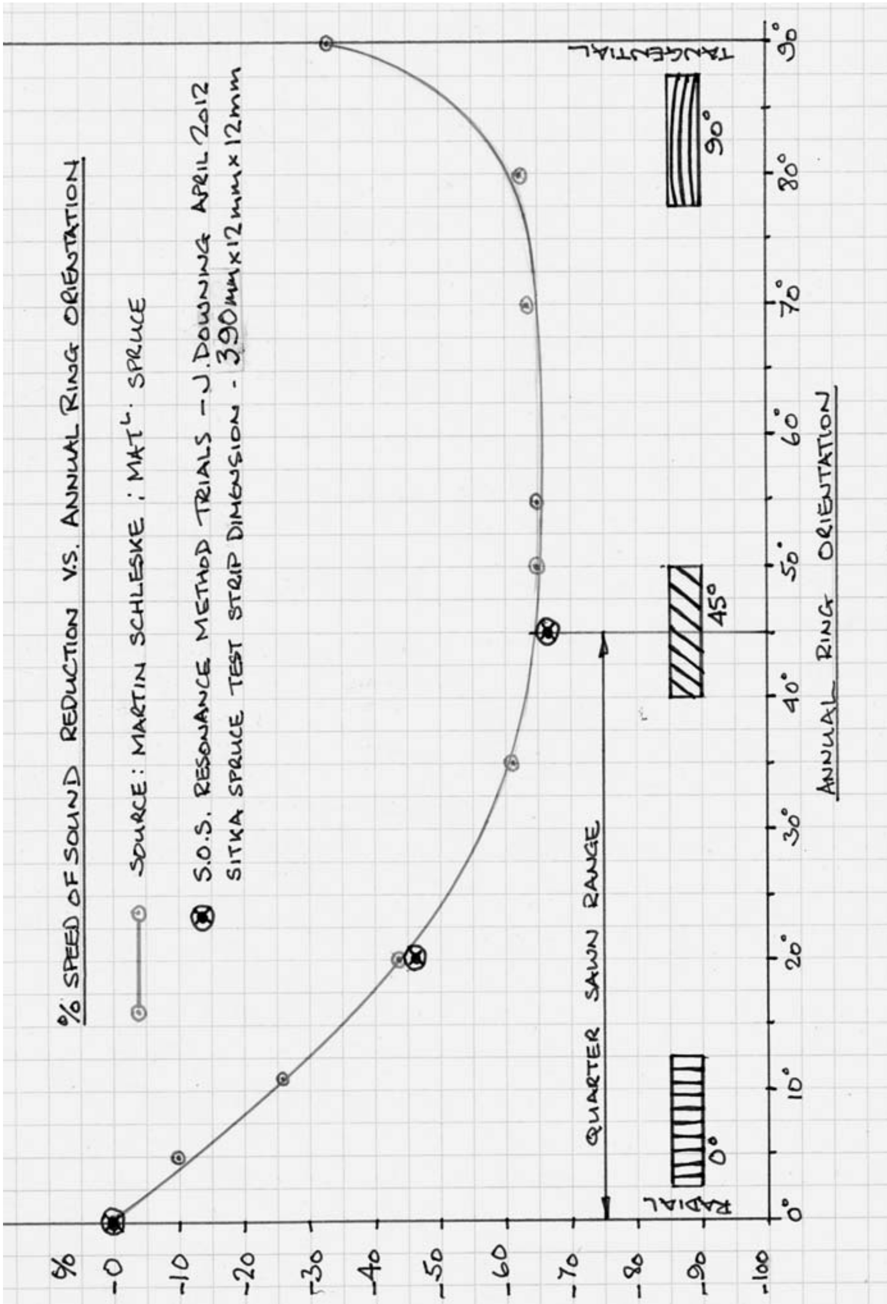

Fig 1

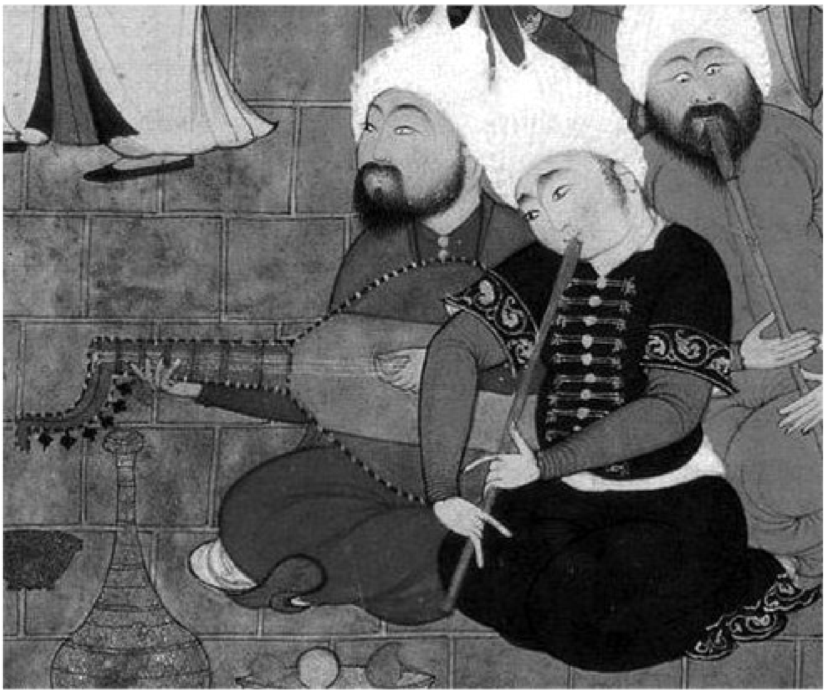

Fig 2

Fig 3