# Supplementary Materials

## Three-dimensional transformation of shape measurements

To assess the three-dimensional (3D) measurements of analyzed mitochondria from STED images, we estimated the shape of a mitochondrion as a cylinder with hemispherical ends, with a radius of (Supplementary figure 1A). To assess the 3D surface area of the boundary membrane () of a mitochondrion, we first considered a ring-shaped portion of the surface area, with a radius of and a width of (Supplementary figure 1A). The surface area of such shape will be

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Extending this to the whole boundary membrane (which consists of many such ring-shaped portions), the surface area for each mitochondrion was approximated as

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where is the perimeter measured by 2D tracing of mitochondria, and is half of the diameter manually measured for each mitochondrion.

To estimate the surface area of cristae, cristae were considered as flat disks with a diameter of (Supplementary figure 1A). Hence, the surface area of a crista is

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The surface area of all cristae was calculated in all analyzed mitochondria, where the length measured of each traced crista was used as .

The [cristae/IMM]% of each mitochondrion was calculated by

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