The general anatomy of the cardiac conduction system (CCS) has been known for 100 years, but its complex irregular 3D geometry is not well understood largely because the specialised tissue cannot be easily distinguished from working myocardium. The best anatomical descriptions come from serial sectioning of preparations taken from appropriate areas of the heart. Low X-ray attenuation has formerly ruled out micro-computed tomography (micro-CT) to resolve topology of soft tissue, but incorporation of high molecular weight contrast agents enhances differential attenuation and allows visualisation of fine detail. Using an iodine based contrast agent, we obtained exquisite high resolution contrast enhanced micro-CT images of cardiac tissue from rat and rabbit in which the three major subdivisions of the CCS can be differentiated from the surrounding contractile myocardium, and visualised in 3D. The sinoatrial node and the associated ring bundle, the atrioventricular conduction axis (including inferior nodal extension and penetrating bundle), His bundle, bundle branches and Purkinje network can be objectively identified by differential attenuation. Purkinje fibres within the ventricles appear both as structures running on the endocardial surface and free running in the luminal cavity. Controversially, analogous structures are present in the atria, mainly on or near to the endocardial surface. Although the current findings are consistent with existing anatomical representations, the new images offer superior resolution and are the first 3D representations of the CCS within intact mammalian hearts. The method promises to improve the anatomical fidelity of computational models designed to understand complex normal and pathological conduction within the heart.