MODEL	Kind of model	Species (anatomy)	Model extension	Anatomical information	Segmentation method	Meshing	Fibre orientation	CCS	Endocardium detail	Other features	Model purpose	Online availability
Koushanpour & Collings, 1966 [1]	Geom	Rat, cat, turtle	LV	ExpM							MA	
Okajima *et al.* 1968 [8]	Anat	Human	BV	HS(3mm)	MD	vFEMh(3mm)		HPS, AK(Dog)			EP	
Ghista & Sandler, 1969 [2]	Geom	Human	LV	VLV							MA	
Janz & Grimm, 1972 [3]	Geom	Rat	LV, FAn	HS		vFEMh(198el)					MA	
Horan *et al.* 1978 [9]	Anat	Human	LV	HS(18)	MD	vFEMh(1675el,3.2mm)		AP, Dur			EP	
Miller & Geselowitz, 1978 [10]	Anat	Human	BV	HS(16,4.64mm)	MD	CA(4000,3.75mm)					EP	
Vinson *et al.* 1979 [185]	Anat	Human	LV	VLV	M	vFEMh(36el)					MA	
Van den Broek, 1980 [4]	Geom	Rabbit	LV	ExpM, ML			RBM				MA	
Aoki *et al.* 1987 [14]	Anat	Human	BV	pHS(7)	M	CA(50e3,1.5mm)		HPS, Dur			EP	
Thakor & Eisenman, 1989 [15]	Anat	Dog	BV	pHS(1.5mm)	M	vFEMh(1473el)		Purk, AK			EP	
Nielsen *et al.* 1991 [12]	Anat	Dog	BV	ExpM		vFEM-H(24el,41n)	DExp(SH)		Pap		MA, EP	AMDB
Creswell *et al.* 1992 [26]	IM	Dog	BV	iMRI(11,5mm)	M	vFEMh(x)						
Lorange & Gulrajani, 1993 [27]	IM	Human	WH	eCT(132)		CA(25e4,1mm)	Ventricles	HPS, 1120-PMJ			EP	
Colli Franzone *et al.* 1998 [5]	Geom		LV			vFEMh(x)	RBM	AP, Dur			EP	
Vetter & McCulloch, 1998 [11]	Anat	Rabbit	BV	HS(2-3mm)		vFEMx	DExp(SH)				EM	1
Siregar *et al.* 1998 [18]	CAD	Human	WH, GCV	ML		CA(x)	Lit	AVN, HPS, Dur			EP	
Yamaki *et al.* 1999 [186]	Anat	Human	WH			CA(50e3,1.5mm)		SAN, AVN, HPS, Dur		ISC	EP	
Freudenberg *et al.* 2000 [16]	Anat	Human	WH	pHS-VHP(1mm)	SA2D: CTS	CA(x)		SAN, AVN, HPS, AK(Human)	Pap		EP	
Harrild & Henriquez, 2000 [19]	CAD	Human	A	ML		vFEMh(25e4el,0.55mm)		Atr	Pec, FO		EP	
Winslow *et al.* 2000 [28]	IM	Rabbit	BV	eMRI(128,469 µm)	SA2D: SN	vFDG(x)	DTI(SH)				EP	
Blanc *et al.* 2001 [22]	Geom	Human	A	ML		sFEMt(250e3n,0.2mm)					EP	
Zemlin *et al.* 2001 [23]	Anat	Human	A	pHS-VHP(1mm)	SA2D: CTS	sFEMt(6e5el,0.28mm)	DExp(DH)	Atr	Pec, CT		EP	
Schulte *et al.* 2001 [49]	IM, PS, Def	Human	BV, FAn	iMRI(5mm)	M	sFEM-H					MBS	
Virag *et al.* 2002 [29]	IM, LD	Human	A	xMRI	M	sFEMt(50-400e3n)			FO		EP	
Lorenzo-Valdés *et al.* 2002 [42]	At	Human	BV, EpLV	14-iCine-MRI(8-10)	M						MBS-TCM	
Frangi *et al.* 2002 [51]	At + Stat	Human	BV, EpLV	14-iMRI(10mm)	M	sFEMt(x)					MBS	
Kerckhoffs *et al.* 2003 [6]	Geom		LV			EP - vFEMh (10e3el,11e3n,2mm) Mec - vFEMh(108el,3.2e3n)	RBM	AP(4), Dur			EM	
Stevens *et al.* 2003 [13]	Anat	Pig	BV	ExpM		vFEM-H(79el)	DExp(SH)				Mec	
Sermesant *et al.* 2003 [76]	IM, Def	Dog	BV	eDT-MRI	SA2D: CM	vFEMt(10e3el,2e3n)	DTI(DH)			LAR	MBS	
Lötjönen *et al.* 2004 [55]	At + Stat	Human	WH, EpV	25-iMRI(6-7mm)	M	sFEMt(x)			Pap		MBS	
Helm *et al.* 2005 [30]	IM	Dog	BV	eDT-MRI(0.8mm)	SA2D: SN	vFEM-H(24el)	DTI(SH)					
Haddad *et al.* 2005 [37]	IM, PS, Dyn	Human	WH, GCV, pCT	iMRI(2mm), iCine-MRI(7mm)	WH - M pCT - SA2D	sFEMt(x)				MCC		
Perperidis *et al.* 2005 [54]	At, Dyn	Human	BV, EpLV	26-iCine-MRI(10mm)	M + Reg	sFEMt(x)			Pap	MCC	O	
Bodin & Kuz'min, 2006 [20]	CAD	Human	WH, OEp, GCV	O		sFEMt(x)					EP	
Seemann *et al.* 2006 [24]	Anat	Human	A	pHS-VHP	SA2D: RG, SN	vFEMh(1.58e6el)		SAN, Atr	Pec, FO		EP	
Appleton *et al.* 2006 [38]	IM, PS, Dyn	Human	BV	iCine-MRI(9)	A2D: CM, SN	CA(40e3)		HPS		MCC(20)	EP	
Yang *et al.* 2006 [40]	IM, PS	Human	WH, OE	iMS-CT(1mm)	SA2D: SN, LS							
Burton *et al.* 2006 [44]	IM, HD	Rabbit	BV, fCT	eMRI(24.4µm), pHS-St(10µm)	MRI - SA2D: CM pHS - A2D: CTS	vFEM	IM3D(SH)		Pap, TC	LT	EP	

Table S1 (part 1). The main features of the sixty reviewed 3D cardiac computational models and the methods used for its development

MODEL	Kind of model	Species (anatomy)	Model extension	Anatomical information	Segmentation method	Meshing	Fibre orientation	CCS	Endocardium detail	Other features	Model purpose	Online availability
Sermesant *et al.* 2006 [7]	Geom, Def	Human	BV			vFEMt(20e3el,4e3n)	DTI(DH)			LAR	Mec, MBS	
Lorenz & von Berg, 2006 [56]	At + Stat	Human	WH, EpLV, GCV, pCT	27-iMS-CT(0.5mm)	SA3D: Fit	sFEMt(x)					MBS	AMDB
Sermesant *et al.* 2006 [160]	(1) Anat, Def, Dyn (2) IM, Def, Dyn	Dog	BV	(1) ExpM (2) eDT-MRI(x)	SA2D: CM	vFEMt(40e3el,7e3n)	(1) Lit(Dog) (2) DTI(DH)	AP, Dur		LAR	EP, Mec, MBS-TCM	
Trunk *et al.* 2007 [17]	Anat	Human	WH, GCV, pCT	pHS-VHP	M	Vox(1mm)					O	
Ordas *et al.* 2007 [43]	At	Human	WH, pCT	100-iMS-CT(2mm)	A3D: Reg	vFEMt(0.5mm)	RBM	Atr, HPS, AK(Human)		LAR, TH	EP	AMDB
Peyrat *et al.* 2007 [77]	At	Dog	WH	9-eMRI			DTI(SH)					2, AMDB
Arevalo *et al.* 2008 [31]	IM	Dog	WH	eMRI(0.8mm)	SA2D: CM, RG, LS	vFEMt (29e6el,5e6n,0.4mm)	DTI(SH)		Pap, TC	ISC	EP	
Plotkowiak *et al.* 2008 [32]	IM	Rabbit	BV	eMRI(24.4μm)	A2D: LS	vFEMt(3.7e6el,83e4n)			Pap		EP	
Ecabert *et al.* 2008 [47]	At + Def, Stat	Human	WH, EpLV, GCV	28-iMS-CT (0.67-3mm)	SA3D: Fit	sFEMt (14.7e3el,7.3e3n,2.5-5mm)					MBS	AMDB
Ruiz-Villa *et al.* 2009 [21]	CAD	Human	A	ML		vFEMh(51e3el,1e5n)	Lit(Human)	Atr	Pec, FO	LAD	EP	
Niederer *et al.* 2009 [39]	IM, PS	Human	BV	iMRI(x)	M	vFEM-H(112el,183n)	Lit(Dog)				Mec	
Plank *et al.* 2009 [45]	IM, HD	(1) Rabbit (2) Rat	BV	eMRI(24.4μm), pHS-St(10μm)	MRI - SA2D: LS, CM pHS-A3D: Reg(MRI)	(1) vFEMt (24e6el,4.3e6n,125μm)	(1) RBM (2) DTI(SH)		Pap, TC	LAR	EP	
Vadakkumpadan *et al.* 2009 [53]	IM, HD	Rabbit	BV, fCT	eMRI(24.5μm)	SA2D: CM, RG, LS	vFEMx(31e6el,50μm)	DTI(SH)	Purk, hrMRI	Pap, TC	ISC	EP	
Heidenreich *et al.* 2010 [33]	IM	Human	BV	eDT-MRI(0.8mm)	M[11]	vFEMh (1.3e6el,1.4e6n,0.4mm)	DTI(SH)	HPS		RVD, TH	EP	
Romero *et al.* 2010 [41]	IM, PS	Human	BV	iMS-CT(x)	A3D: MBS	vFEMt(15-21e6el,2.5-3.5e6n,>0.5mm)	RBM	Purk, Dur		LVH, LVD (3 models)	EP	
Bishop *et al.* 2010 [46]	IM, HD	Rabbit	BV, fCT, FAn	eMRI(24.4μm)	SA2D: LS	vFEMt (41.5e6el,7e6n,125μm)	RBM		Pap, TC, CTen	LAR	EP	3
Wenk *et al.* 2010 [50]	IM	Sheep	LV, FAn	iMRI(x), pHD		vFEMh(x)	Lit(Dog)		Pap, CTen	ISC	Mec	
Gurev *et al.* 2011 [34]	IM	Dog, Human (3 models)	BV	eMRI(x)	SA2D: CM, RG, LS	EP - vFEMx (1.7e6el,1.4e6n) Mec - vFEM-H (172el,356n)	DTI(SH)	AP, Dur			EM	
Deng *et al.* 2012 [35]	IM	Human	WH	eCT(531,0.33mm)	SA2D: CM, RG		DExp(SH)	SAN, Atr, AVN, HPS, AK(Human)	Pec, FO		EP	
Zhao *et al.* 2013 [25]	Anat, HD	Sheep	A	pHS(50μm)	SA2D: CM, RG	vFDG(0.1mm)	IM3D(SH)	SAN, Atr	Pec, CT		EP	
Aslanidi *et al.* 2013 [36]	IM, HD	Dog	A	eMicro-CT(36μm)	SA2D		eMicro-CT(SH)	AVN, Atr	Pec			
Hoogendoorn *et al.* 2013 [52]	At + Stat, Dyn	Human	WH, EpLV, GCV, pCT	138-iMS-CT(2mm)	A3D: Reg	sFEMt(16e3n)				LAR, MCC(15)	MBS-TCM, O	4

Table S1 (part 2). The main features of the sixty reviewed 3D cardiac computational models and the methods used for its development

AMDB: Anatomical Model Database (see ref. [187]). http://amdb.isd.kcl.ac.uk:8080/AMDBWebInt/

1: http://cmrg.ucsd.edu/

2: https://team.inria.fr/asclepios/data/

3: https://chaste.cs.ox.ac.uk/trac/browser/data/public

4: http://www.cistib.org/cistib_shf/index.php/translation/downloads

Kind of model	
Geom	Geometrical shape-based model (ellipsoid-based)
SAnat	Simple anatomical model
IM	Image-based model
PS	Patient-specific model
CAD	CAD model
Def	Deformable model
Stat	Statistical cardiac model
At	Cardiac atlas
Dyn	Dynamic model
HD	High level of anatomical detail
LD	Low level of anatomical detail
Model extension	
LV	Left ventricle model
BV	Bi-ventricle model
A	Bi-atrial model
WH	Whole heart model
GCV	Great cardiac vessels
pCT	Part of coronary tree
fCT	Full coronary tree
OE	Only endocardium
OEp	Only epicardium
EpLV	Only epicardium for LV
EpV	Only epicardium for ventricles
FAn	Fibrous annulus of atrio-ventricular valves
Anatomical information	
ExpM	Experimental measurements taken on explanted hearts
ML	Measurements taken from the literature
pHD	Pictures of heart dissections
HS(n,mm)	Histo-anatomical slices. n: number of slices. mm: slice thickness.
pHS(n,mm)	Pictures of histo-anatomical slices
pHS-St(n,mm)	Pictures of histo-anatomical slices with special staining
eMRI(n,mm)	*Ex-vivo* MRI
iMRI(n,mm)	*In-vivo* MRI
N-iMRI(n,mm)	*In-vivo* MRI. N: population size (for atlases)
eCT(n,mm)	*Ex-vivo* CT
iCT(n,mm)	*In-vivo* CT
N-iCT(n,mm)	*In-vivo* CT
VLV	*In-vivo* ventriculograhy of the LV (cine-angio-cardiography)
Segmentation method	
MD	Manually drawn
M	Manual segmentation
SA2D	Semi-automatic 2D (slice by slice), with some manual interaction
A2D	Automatic 2D, without any manual interaction
SA3D	Semi-automatic 3D segmentation, with some manual interaction
A3D	Automatic 3D segmentation, without any manual interaction
CM	Classical image processing methods (*thresholing, edge detection, morphological op., etc.*)
CTS	Colour-thresholding segmentation
RG	Region growing
SN	Snakes
LS	Level sets
MBS	Model-based segmentation
Reg	Registration with a previously manually segmented image
Fit	Fitting an initial mesh to the target image

General	
x	*Feature not included* or *Method not reported*
O	Other options
Meshing	
CA(n,mm)	Cellular automaton. n: number of cells. mm: spatial resolution.
sFEM-t(el,n,mm)	Surface finite element mesh with triangular elements. el: number of elements. n: number of nodes. mm: spatial resolution.
vFEM-h(el,n,mm)	Volumetric finite element mesh with hexahedral elements
vFEM-t(el,n,mm)	Volumetric finite element mesh with tetrahedral elements
sFEM-H(el,n,mm)	Surface finite el. mesh based on cubic Hermite basis functions
vFEM-H(el,n,mm)	Volumetric finite el. mesh based on cubic Hermite basis functions
vFDG(mm)	Volumetric finite difference grid. mm: spatial resolution.
Vox(mm)	Voxels-based volumetric model (*not FEM*). mm: spatial resolution.
Fibre orientation	
RBM	By a rule-based method based on Streeter's findings
DTI	From *ex-vivo* DTI images
SH	From the same heart used for the anatomical reconstruction
DH	From a different heart than used for the anatomical reconstruction
DExp	From direct experimental measurements
Lit(sp)	Taken from the literature. sp: species
IM3D	From the volumetric image assembled from histological slices
Cardiac conduction system	
AP(n)	CCS emulated by activation points on the endocardial surfaces. n: number of activations points
Dur	From the activation maps obtained by Durrer *et al.* 1970
HPS	His-Purkinje fibres
AVN	AV (atrio-ventricular) node
SAN	SN (sino-atrial) node
Purk	Only Purkinje fibres
AK(sp)	From the anatomical knowledge. sp: species
N-PMJ	Purkinje-muscle junctions. N: number of PMJs
Atr	Atrial conduction bundles: crista terminals, Bachmann's bundle and pectinate muscles
hrMRI	Free-running Purkinje fibres from high-resolution *ex-vivo* MRI
Endocardium detail	
Pap	Papillary muscles
TC	Trabeculae carnae
Pec	Pectinate muscles
CT	Crista terminalis
FO	Fossa ovalis
CTen	Chordae tendineae
Other features	
LAR	Labelling of anatomical regions
TH	Electrophysiological transmural heterogeneity in ventricular wall
RVH	RV hypertrophy
LVH	LV hypertrophy
LVD	LV dilation
LAD	Left atrium dilation
ISC	Infarct-derived ischemic scar in LV, including core and border zone
MCC(n)	Motion due to the cardiac cycle. n: number of phases
LT	Labelling of tissues (histological information)
Model purpose	
MA	Mechanical analysis
EP	Simulation of cardiac electrophysiology
EM	Simulation of cardiac electro-mechanics
Mec	Simulation of cardiac mechanics
MBS	Model-based segmentation
MBS-TCM	Model-based segmentation with tracking of cardiac motion

Table S2. List of acronyms used in the table of reviewed 3D cardiac computational models (Table S1)

Content of Table S1

First column in Table S1, named "*Kind of model*", corresponds to a proposed classification based on the level of anatomical realism achieved by the model and the method used for the 3D reconstruction of the cardiac anatomy.

Second column, called "*Species (anatomy)*", specifies the animal species whose anatomy is modelled.

Under the heading "*Model extension*" the cardiac chambers and structures included in each model are detailed.

Next two columns provide information about the source of the "*Anatomical information*" and the "*Segmentation method*" (for image-based models) used to build each model, respectively.

The column labelled as "*Meshing*" shows the approach used to generate the 3D computational model from the reconstructed cardiac geometry and, if reported, some details such as mesh resolution.

"*Fibre orientation*" and "*CCS*" (cardiac conduction system) columns report whether or not these features are included in the model and, if so, the approach used to include them.

"*Endocardium detail*" column gives information about the level of anatomical detail achieved in the reconstructed endocardial surfaces, both in ventricles and atria.

Next column, named "*Other features*", collects miscellaneous information, such as the inclusion in the model of ischaemic scars, some kind of anatomical variation, labelling of interesting anatomical regions, etc.

"*Model purpose*" column specifies the final application for which each model was originally developed.

The last column, "*Online availability*", reports whether the model is available online, providing the link if so.