3D soybean model

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1 Introduction

This document is a help file that describes the 3D soybean model. The files used in this model are listed below.

1.1 Model functions

- Driver: runSoybeanCanopy.m
- Functions: SoybeanCanopy.m, soybeanPlant.ms, soybeanStem.m, soybeanLeaf.m, aSoybeanPetiole.m, youngLeafModification.m, stageDetermine.m, aPPFDsensor.m, aGround.m

1.2 Model inputs

- M_mean.txt
- M_std.txt (Currently not used)
- M_Vx.txt

1.3 Model outputs

- CM_VXXX_repXXX_M_mean.txt

2 Input files

This section describes the input files necessary to run the 3D model.

2.1 M_mean.txt

This file provides the details of the physical structure of the plant including the lengths, widths and angles. A sample file is presented in table 2. The columns in the table are explained below:

- StemBranchID: This indicates whether the branch is a main stem branch (value 0) or a side branch (value 1) or a branch off a side branch (value 2) and so on.
- node: This indicates the growth stage of the plant. Petioles and branches occur at nodes. The nodes start from cotyledon stage VC (-1), to the unifoliate leaf V0 (0), to the first trifoliate leaf V1 (value 1) and so on upto V16.

- branchAngle: This is the angle the the side branch makes with the main branch. Note that when StemBranchID has a value of 0 the branch angle value is 0.
- pet.1Angle: This is the angle that the petiole makes with respect to the vertical. An angle of 0 indicates that the petiole is vertical and pointing along the stem/branch and an angle of 90 indicates the petiole is at right angles to the stem/branch.
- pet.2Angle: This is the angle that the petiole makes with respect to the horizontal with 0 being along the row.
- mid-ifAngle: This is the angle that the petioliole makes with the petiole.
- Left_angle: This is the angle that the left leaf makes with respect to the petiole.
- Right_angle: This is the angle that the right leaf makes with respect to the petiole.
- Middle_angle: This is the angle that the middle petioliole makes with respect to the petiole.
- internode: This is the distance [mm] between two nodes in the branch or stem.
- pet.1: This is the length [mm] of the petiole.
- pet.2: This is the length [mm] of the middle petioliole.
- lat1L: This is the length [mm] of the left leaf.
- lat1W: This is the width [mm] of the left leaf.
- lat2L: This is the length [mm] of the right leaf.
- lat2W: This is the width [mm] of the right leaf.
- midL: This is length [mm] of the middle leaf.
- midW: This is the width [mm] of the middle leaf.

Fig. 1 shows the different measurements in the plant.

2.2 M_std.txt

This file has the same format as the M_mean.txt file (Table 2). The values in this file represents standard deviations of the mean values in M_mean.txt. Currently this file is not being used.

2.3 M_Vx.txt

This file helps us to identify which the growth stage of the plant based on the day of the year. A sample file is presented in table 1. The columns in the table are explained below:

- DOY: This is the day of the year
- Vx_mean_for_mainStem: Mean number of nodes on the main stem.
- Vx_std_for_mainStem: Standard deviation of number of number of nodes on the main stem.
- Senescense_add: Number of nodes on the main stem that have senesced.
- Ambient Vcmax mean: Vcmax25 of the top leaf in the growth stage.
- Ambient Jmax mean: Jmax25 of the top leaf in the growth stage.
- Vx_for_Br1: Mean number of nodes in the branch on the main stem node V1.
- Vx_for_Br2: Mean number of nodes in the branch on the main stem node V2.

- Vx_for_Br3: Mean number of nodes in the branch on the main stem node V3.
- Vx_for_Br4: Mean number of nodes in the branch on the main stem node V4.
- Vx_for_Br5: Mean number of nodes in the branch on the main stem node V5.
- Vx_for_Br6: Mean number of nodes in the branch on the main stem node V6.

Acknowledgments

Table 1: M_Vx.txt

StemBranchID	node	branchAngle	pet.1Angle	pet.2Angle	mid-ifAngle	Left_angle	Right_angle	Middle_angle	internode	pet.1	pet.2	lat1L	lat1W	lat2L	lat2W	midL	midW
0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	80	175	180	0	0	0	30.4	25	3	0	0	0	0	52	36
0	0	0	80	175	180	0	0	0	30.4	25	3	0	0	0	0	52	36
0	1	0	59	175	190	88.423	87.138	9.974	22.8	100	10	38.77	26.03	46.58	33.11	51.82	35.6
0	2	0	51	175	183	104.543	85.601	3.333	24.05	125	18	57.77	36.01	60.98	36.58	70.91	42.18
0	3	0	49	175	190	100.903	66.116	10.433	30.15	150	21	61.75	37.16	61.96	39	77.24	47.53
0	4	0	43	175	152	59.187	125.292	27.525	42.65	180	36	76.08	47.23	68.35	40.54	94.83	57.1
0	5	0	37	175	166	107.897	114.586	13.156	48.35	200	34	77.11	50.54	78.34	49.02	87.5	48.26
0	6	0	35	175	172	108.75	112.271	7.837	52.4	220	34	77.17	53.54	78.32	49.21	87.47	50.93
0	7	0	33	175	188	135.985	133.854	7.575	61.1	230	34	79.9	60.58	89.27	60.39	93.9	58.21
0	8	0	30	175	199	86.797	96.911	19.058	61.85	220	34	87.24	61.64	92.83	60.71	101.21	56.03
0	9	0	28	175	162	68.749	56.933	17.795	75.95	200	34	94.58	62.69	96.38	61.04	108.53	53.85
0	10	0	26	175	187	119.358	128.298	6.602	71.4	180	34	99.92	58.48	86.42	50.94	108.34	55.65
0	11	0	24	175	190	104.487	135.439	9.71	72.32	150	34	89.15	45.06	86.76	49.06	98.2	50.06
0	12	0	22	175	156	68.232	61.892	23.928	64.05	125	34	73.57	37.61	74.32	45.27	90.11	43.54
0	13	0	19	175	181	91.397	79.76	1.126	51.83	100	34	71.07	36.15	76.4	40.82	84.63	40.28
0	14	0	17	175	149	113.167	68.103	30.734	42.17	75	34	52.46	21.98	50.84	28.11	69.86	25.46
0	15	0	16	175	184	65.556	60.068	3.838	39.5	50	34	33.84	16.82	39.94	17.09	58.42	16.22
0	16	0	15	175	184	65.556	60.068	3.838	22.75	25	34	33.84	16.82	39.94	17.09	58.42	16.22
1	1	49	59	175	180	67.103	78.69	0	64	100	34	61.64	48.08	64.2	51.45	73.99	52.68
1	2	49	51	175	207	62.317	130.973	26.713	90	125	34	76.98	51.42	69.21	46.27	85.21	49.63
1	3	49	49	175	199	96.932	91.326	18.668	74	150	34	76.74	50.26	69.94	47.88	86.26	52.32
1	4	49	43	175	174	83.884	115.61	6.114	80.5	180	34	75.05	49.97	78.05	50.7	88.15	51.55
1	5	49	37	175	174	126.803	86.131	5.642	49	200	34	68.6	44.43	69.97	41.78	80.71	46.3
1	6	49	35	175	157	112.875	71.202	22.771	41	200	34	44.62	21.79	35.87	21.43	48.09	21.35

Table 2: M_mean.txt

DOY	Vx_mean_for_mainStem	Vx_std_for_mainStem	Senescense_add	Ambient Vcmax mean	Ambient Jmax mean	Vx_for_Br1	Vx_for_Br2	Vx_for_Br3	Vx_for_Br4	Vx_for_Br5	Vx_for_Br6
168	1	0.06	0	114.46	177.69	0	0	0	0	0	0
171	1.6	0.1	0	114.46	177.69	0	0	0	0	0	0
174	2.33	0.15	0	114.46	177.69	0	0	0	0	0	0
177	3.25	0.2	0	114.46	177.69	0	0	0	0	0	0
180	4	0.25	0	114.46	177.69	0	0	0	0	0	0
183	4.75	0.3	0	114.46	177.69	0	0	0	0	0	0
186	5.4	0.34	0	114.46	177.69	0	0	0	0	0	0
189	6	0.38	0	112.15	177.23	0	0	0	0	0	0
192	6.75	0.42	0	109.85	176.77	0	0	0	0	0	0
195	7.5	0.47	0	107.54	176.31	1	0	0	0	0	0
198	8.25	0.52	0	105.62	175.69	2	1	0	0	0	0
201	9	0.56	0	104.46	174.77	3	2	1	0	0	0
204	10	0.63	0	103.31	173.85	4	3	2	1	0	0
207	11	0.69	0	102.15	172.92	4	4	3	2	1	0
210	12.25	0.77	0.1	101	172	4	5	4	2.5	1.5	1
213	13	0.82	0.1	103.6	177.8	4	5	5	3	2	1.5
216	14.25	0.89	0.1	106.2	183.6	4	5	6	3.5	2.5	2
219	15	0.94	0.1	108.8	189.4	4	5	6	4	3	2.5
222	15.33	0.96	0.11	111.4	195.2	4	5	6	4.5	3.5	3
225	15.67	0.98	0.11	114	201	4	5	6	5	4	3
228	16	1	0.11	114.8	208	4	5	6	5	4	3
231	17	1.07	0.12	115.6	215	4	5	6	5	4	3
234	17.38	1.09	0.12	116.4	222	4	5	6	5	4	3
237	17.75	1.11	0.12	117.2	229	4	5	6	5	4	3
240	18	1.13	0.12	118	236	4	5	6	5	4	3
243	18	1.13	0.13	112.5	227.5	4	5	6	5	4	3
246	18	1.13	0.17	107	219	4	5	6	5	4	3
249	18	1.13	0.29	101.5	210.5	4	5	6	5	4	3
252	18	1.13	0.42	96	202	4	5	6	5	4	3
255	18	1.13	0.47	96	202	4	5	6	5	4	3
258	18	1.13	0.48	96	202	4	5	6	5	4	3
261	18	1.13	0.49	96	202	4	5	6	5	4	3
264	18	1.13	1	96	202	4	5	6	5	4	3
267	18	1.13	1	96	202	4	5	6	5	4	3

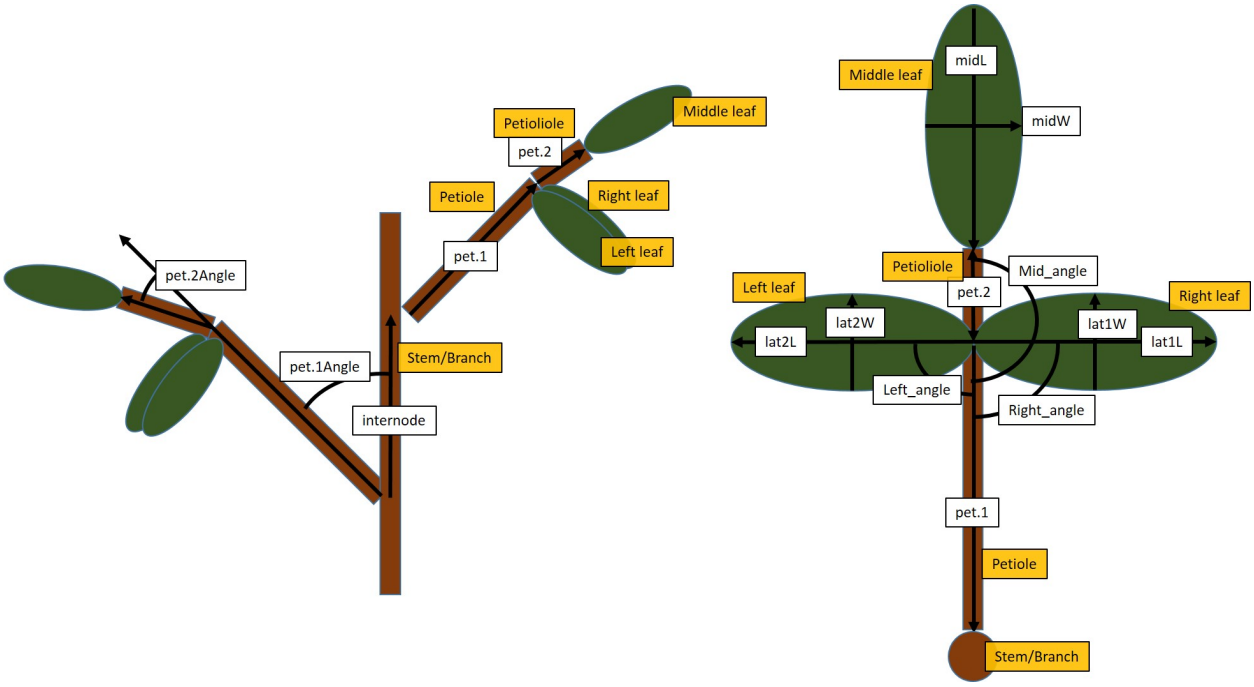

Figure 1: Left figure is the elevation view (front view) and the right figure is the plan view (top view) of the soybean plant.