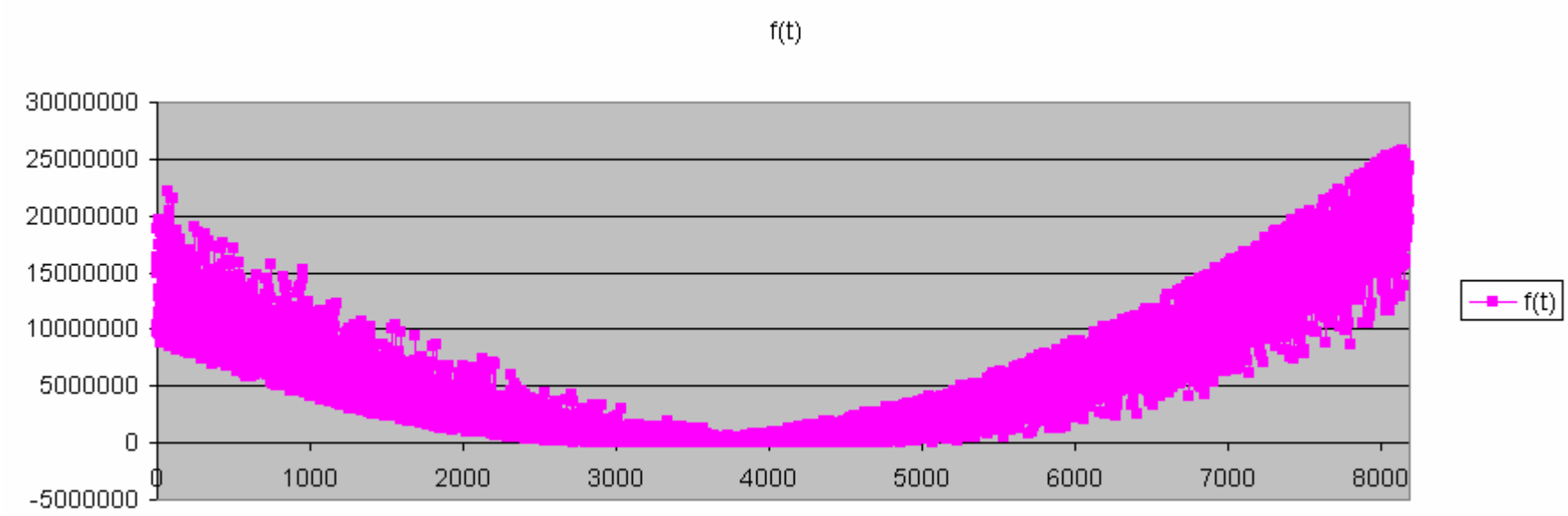
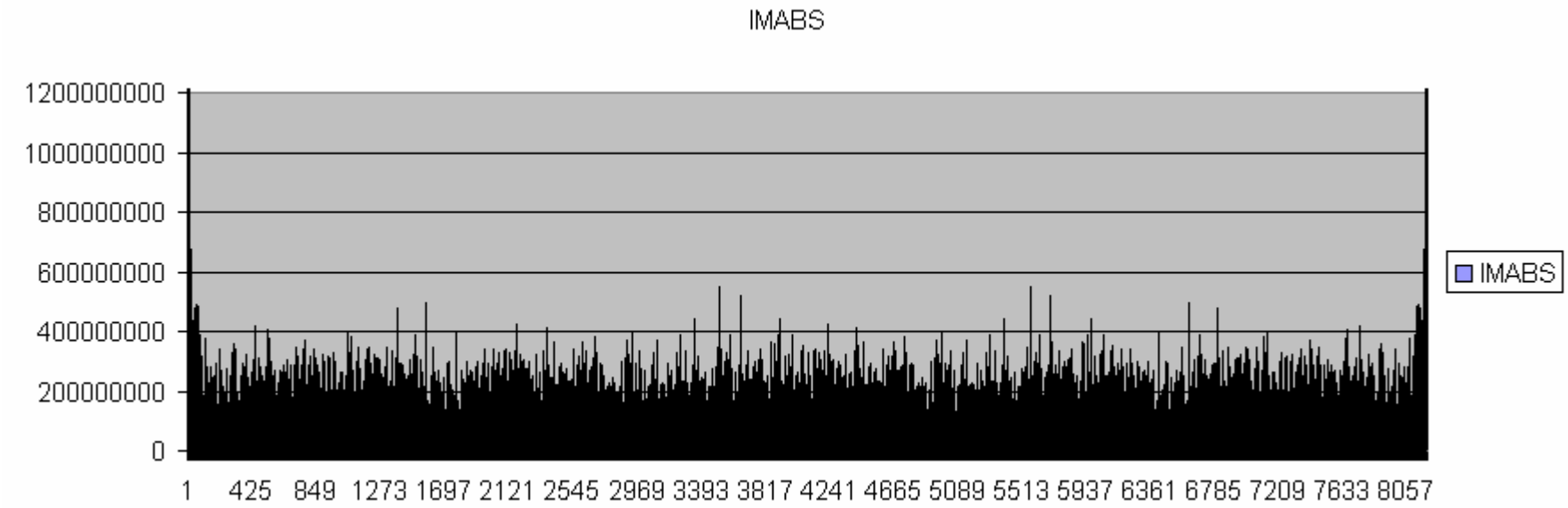
ชุดข้อมูลที่ 1 จำนวน 8192 ตัว ในรูป Time Domain



ในรูป Frequency Domain



การทำ Time Domain เป็น Frequency Domain

k	f(t)	ค่า Fourier Transform แบบแบ่งส่วนคำนวณเอง	IMABS	คู่	Fourier Excel คำนวณเลขคู่	คี่	Fourier Excel คำนวณเลขคี่	W^k
0	9798269.655	48577953233.0434	48577953233	9798269.655	24221126523.3	18843038	24356826709.7434	1
1	18843037.68	27979401681.7162+9090945081.48378i	29419248817	16285034.47	13953673392.608+4523759791.32832i	10406864	14022221176.7195+4577941544.5878i	0.999999705862882-7.66990318742705E-004i
2	16285034.47	6993941285.48866+4519569053.61347i	8327167534	15715556.25	3530780961.78714+2189610726.06882i	14861014	3459582139.21681+2335268005.55463i	0.999998823451702-1.53398018628476E-003i
3	10406864.49	3096877321.63531+2952478509.3715i	4278758990	13579500.61	1533060616.04606+1452135643.33996i	13287546	1560360323.15073+1503937188.27241i	0.999997352766978-2.3009691514258E-003i
4	15715556.25	1809606054.49754+2363875568.45976i	2977008864	13490671.81	808821923.853594+1141177723.00422i	10691443	997028236.639234+1225762453.64853i	0.999995293809576-3.06795676296597E-003i
5	14861013.74	1025402977.35491+1935171556.36272i	2190054844	11490100.91	449562971.574614+815842294.950416i	12869971	571543207.953183+1121529343.86642i	0.999992646580707-3.83494256970622E-003i
6	13579500.61	709037088.045739+1448116244.30249i	1612381546	9709098.134	353879986.729145+634544091.090967i	17390033	351409341.644412+815197945.104063i	0.999989411081928-4.60192612044857E-003i
8183	22364557.34	575496787.285862-1202340786.49257i	1332974088					
8184	18218043.72	716062799.269789-1111524325.06098i	1322207343					
8185	18142272.66	727348185.270115-1219841359.75468i	1420228265					
8186	20616719.81	709037088.045708-1448116244.30248i	1612381546					
8187	24394255.69	1025402977.35485-1935171556.36269i	2190054844					
8188	21385636.89	1809606054.4975-2363875568.45974i	2977008864					
8189	21209632.36	3096877321.6352-2952478509.37148i	4278758990					
8190	19563296.27	6993941285.48847-4519569053.61347i	8327167534					
8191	23966766.93	27979401681.7156-9090945081.48388i	29419248817					

N= 8192

ย่อเพื่อให้เห็นข้อมูลช่วงหลัง

$$\sum_{n=0}^{\frac{N}{2}-1} \varpi^{2nk} x_{2n}$$

$$\sum_{n=0}^{\frac{N}{2}-1} \varpi^{2nk} x_{2n+1}$$

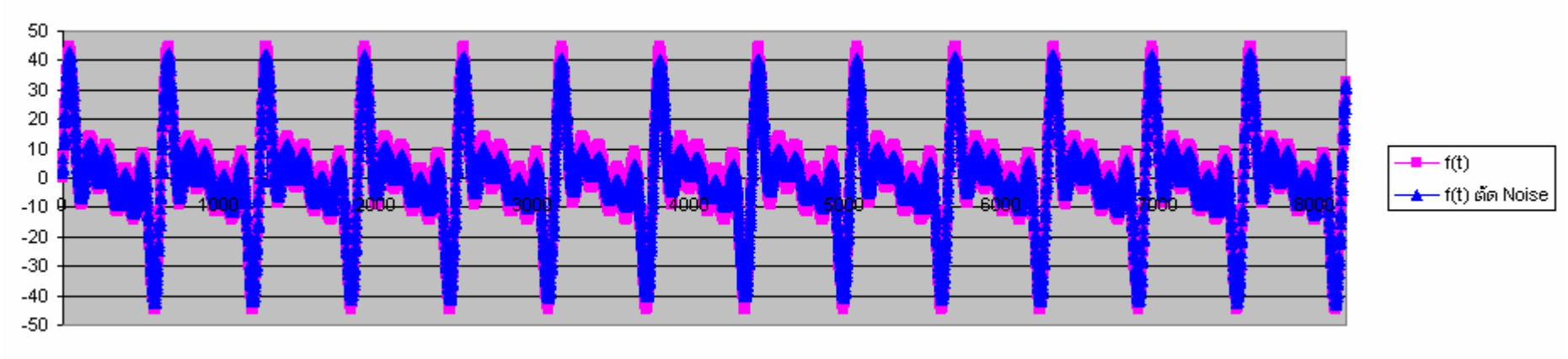
$$\varpi^k = e^{-\frac{j2\pi}{N}k}$$

$$\overline{x}_k = \sum_{n=0}^{\frac{N}{2}-1} \varpi^{2nk} x_{2n} + \varpi^k \sum_{n=0}^{\frac{N}{2}-1} \varpi^{2nk} x_{2n+1} \quad \text{โดย} \quad k = 0,1,\ldots,\frac{N}{2}$$

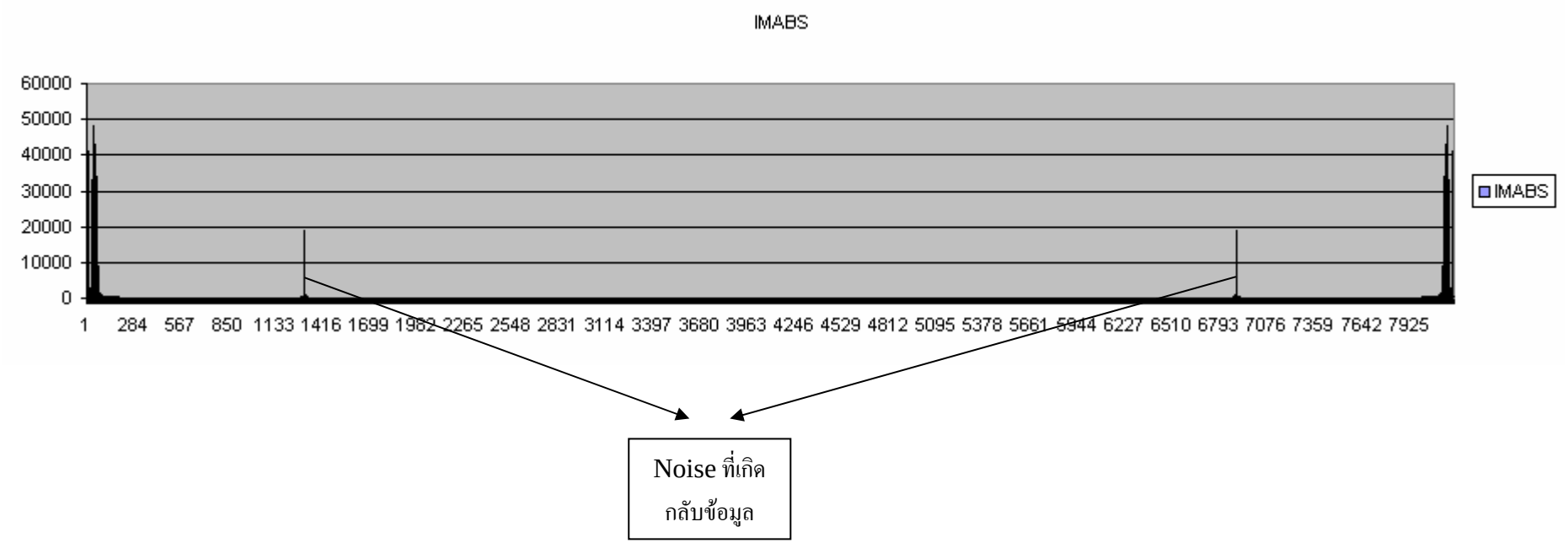
$$\overline{x}_{k+\frac{N}{2}} = \sum_{n=0}^{\frac{N}{2}-1} \varpi^{2nk} x_{2n} - \varpi^k \sum_{n=0}^{\frac{N}{2}-1} \varpi^{2nk} x_{2n+1} \quad \text{โดย} \quad k = 0,1,\ldots,\frac{N}{2}$$

Note: รายละเอียดการคำนวณ **http://beam.to/statistics**

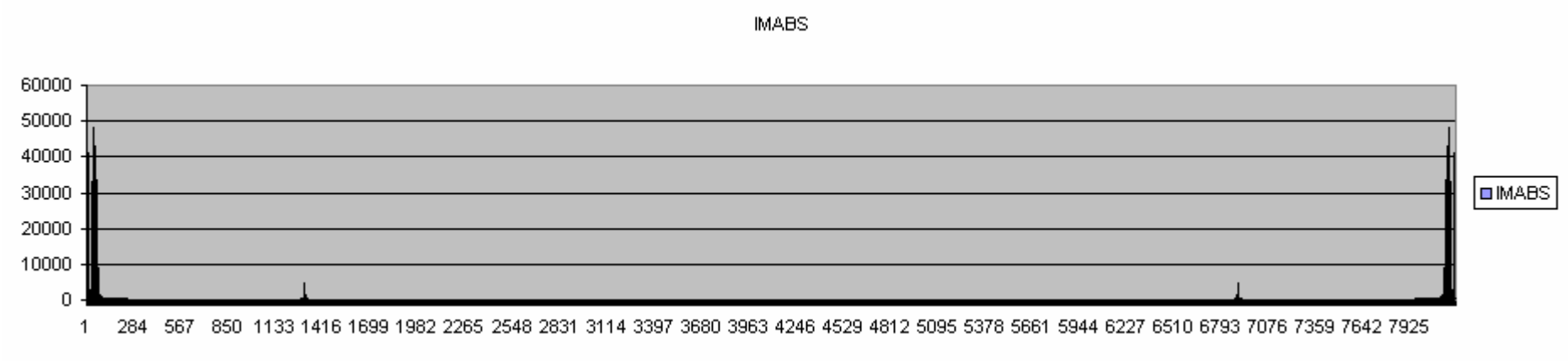
ชุดข้อมูลที่ 2 จำนวน 8192 ตัว ในรูป Time Domain ที่มี Noise และ ได้ทำการตัด Noise แล้ว



ในรูป Frequency Domain ที่มี Noise



ในรูป Frequency Domain ที่ตัด Noise ออกจากชุดข้อมูล



การทำ Time Domain เป็น Frequency Domain

k	f(t)	ค่า Fourier Transform แบบแบ่งส่วนคำนวณเอง	IMABS	คู่	Fourier Excel คำนวณเลขคู่	คี่	Fourier Excel คำนวณเลขคี่	W^k
0	0	390.738913866279	390.7389139	0	188.196261311435	5.716983793	202.542652554844	1
1	5.716983793	391.105974230101-38.8736322405023i	393.0331314	7.563518936	188.379791390481-19.4392183218482i	5.225587157	202.741029217651-19.278919182678i	0.999999705862882-7.66990318742705E-004i
2	7.563518936	392.221211555685-78.508532505772i	400.0013356	2.232269154	188.937409744679-39.2590706566332i	2.709093514	203.343770534594-38.9375823460805i	0.999998823451702-1.53398018628476E-003i
3	5.225587157	394.129117696824-119.750151531418i	411.9197254	7.583025864	189.89136230092-59.8822823727082i	13.72821758	204.374968851069-59.3977658997868i	0.999997352766978-2.3009691514258E-003i
4	2.232269154	396.912415674328-163.63476738111i	429.3201635	16.83791259	191.283010569609-81.8269925024589i	15.38209812	205.879420089784-81.1765277516286i	0.999995293809576-3.06795676296597E-003i
5	2.709093514	400.708316332514-211.552157663564i	453.1241223	12.01225735	193.18095997291-105.788089850785i	11.12170448	207.931429449939-104.96743459196i	0.999992646580707-3.83494256970622E-003i
6	7.583025864	405.740421053671-265.529179624637i	484.9031187	14.80452249	195.697011201966-132.779003041192i	20.92844117	210.65209222436-131.782166648477i	0.999989411081928-4.60192612044857E-003i
8183	24.99758159	433.823030822022+510.827210535142i	670.1841994					
8184	21.74907907	421.305765317346+406.902844061523i	585.7204729					
8185	19.16015153	412.383471126432+328.780617780837i	527.4057469					
8186	20.73507017	405.740421053655+265.52917962465i	484.9031187					
8187	26.11846826	400.708316332512+211.552157663579i	453.1241223					
8188	31.42057822	396.912415674322+163.634767381109i	429.3201635					
8189	32.79204263	394.129117696817+119.750151531433i	411.9197254					
8190	29.96163696	392.221211555675+78.5085325057672i	400.0013356					
8191	26.48434054	391.105974230097+38.8736322405317i	393.0331314					

$$\sum_{n=0}^{\frac{N}{2}-1} \varpi^{2nk} x_{2n}$$

$$\sum_{n=0}^{\frac{N}{2}-1} \varpi^{2nk} x_{2n+1}$$

$$\varpi^k = e^{-\frac{j2\pi}{N}k}$$

N= 8192

ย่อเพื่อให้เห็นข้อมูลช่วงหลัง

การทำ Frequency Domain เป็น Time Domain

k	f(t)	Fourier Transform	IMABS(ตัด Noise แล้ว)	คู่	Fourier Excel คำนวณเลขคู่	คี่	Fourier Excel คำนวณเลขคี่	W^k
0	0	378.212916662217	378.2129167	0	175.670264107373	5.716983793	202.542652554844	1
1	5.716983793	384.339787872973+15.3062587561468i	384.6444515	7.563518936	181.613605033353+34.7406726748009i	5.225587157	202.741029217651-19.278919182678i	0.999999705862882-7.66990318742705E-004i
2	7.563518936	397.437407061157-19.9756694817619i	397.9390907	2.232269154	194.153605250151+19.2737923673769i	2.709093514	203.343770534594-38.9375823460805i	0.999998823451702-1.53398018628476E-003i
3	5.225587157	406.530584070428-110.694476882514i	421.3316781	7.583025864	202.292828674524-50.8266077238041i	13.72821758	204.374968851069-59.3977658997868i	0.999997352766978-2.3009691514258E-003i
4	2.232269154	405.094056878936-212.384396181797i	457.3929674	16.83791259	199.464651774217-130.576621303146i	15.38209812	205.879420089784-81.1765277516286i	0.999995293809576-3.06795676296597E-003i
5	2.709093514	397.145828316592-273.274149881074i	482.0825344	12.01225735	189.618471956988-167.510082068295i	11.12170448	207.931429449939-104.96743459196i	0.999992646580707-3.83494256970622E-003i
6	7.583025864	393.710071052776-283.46046969586i	485.1365353	14.80452249	183.666661201071-150.7102931124151	20.92844117	210.65209222436-131.782166648477i	0.999989411081928-4.60192612044857E-003i
8183	24.99758159	445.243058029848+484.376843272827i	657.9227212					
8184	21.74907907	423.143710830124+343.218976788151i	544.839303					
8185	19.16015153	402.949055387476+286.430568294766i	494.378814					
8186	20.73507017	393.710071052761+283.460469695873i	485.1365353					
8187	26.11846826	397.14582831659+273.274149881088i	482.0825344					
8188	31.42057822	405.094056878931+212.384396181796i	457.3929674					
8189	32.79204263	406.53058407042+110.694476882529i	421.3316781					
8190	29.96163696	397.437407061147+19.9756694817578i	397.9390907					
8191	26.48434054	384.339787872969-15.3062587561169i	384.6444515					

ข้อมูลเริ่มต้น

Inverse กลับ Fourier Excel คำนวณเลขคู่	Inverse กลับ Fourier Excel คำนวณเลขคี่	f(t) ตัด Noise	k
2.77761756171066	4.06461037309606	2.777617562	0
2.9865769254157	1.95046278641876	4.064610373	1
3.2665994886942	7.08918413582882	2.986576925	2
11.2985164220842	13.3553435327039	1.950462786	3
12.7091020587617	11.3125590513017	3.266599489	4
11.7354842997742	14.8839312554126	7.089184136	5
19.1638459768217	21.8645753578814	11.29851642	6
		24.00547526	8183
		25.06276732	8184
		23.71459767	8185
		22.35499697	8186
		23.31736259	8187
		26.75771917	8188
		30.57052289	8189
		32.22521485	8190
		31.13565919	8191

ย่อเพื่อให้เห็นข้อมูลช่วงหลัง

ข้อมูลปรับ Noise

การตรวจสอบคำตอบ

โดยการทำการเปรียบเทียบค่าที่คำนวณได้จากโปรแกรม Excel (Data Analysis) โดยตรง กับการแบ่งส่วน 2 ส่วนแล้วใช้ Excel (Data Analysis) คำนวณที่ล่ะส่วน โดยจัดทำเป็นตัวอย่างให้เห็นว่าได้ผลลัพธ์เท่ากัน มี 5 ตัวอย่างดังนี้

ตัวอย่าง 2^2

k	f(t)	Furier Excel คำนวณ	ค่า Fourier Transform แบบแบ่งส่วนคำนวณเอง	IMABS	IMABS
0	2	14	14	14	14
1	3	-2+2i	-1.99999999999999+2i	2.828427	2.828427
2	4	-2	-2	2	2
3	5	-2-2i	-2.00000000000001-2i	2.828427	2.828427

ค่าที่ทำโดย Excel (Data Analysis)

ค่าที่ทำโดยการแบ่งเป็น 2 ส่วน แล้วใช้ Excel (Data Analysis) ที่ล่ะส่วน

ตัวอย่าง 2^3

k	f(t)	Furier Excel คำนวณ	ค่า Fourier Transform แบบแบ่งส่วนคำนวณเอง	IMABS	IMABS
0	2	35	35	35	35
1	3	-6.12132034355964+2.70710678118655i	-6.12132034355964+2.70710678118655i	6.693205	6.693205
2	4	-2+i	-2+i	2.236068	2.236068
3	5	-1.87867965644036-1.29289321881346i	-1.87867965644036-1.29289321881344i	2.280572	2.280572
4	6	1	1	1	1
5	5	-1.87867965644036+1.29289321881345i	-1.87867965644036+1.29289321881345i	2.280572	2.280572
6	6	-2-i	-2-i	2.236068	2.236068
7	4	-6.12132034355964-2.70710678118654i	-6.12132034355964-2.70710678118656i	6.693205	6.693205

ค่าที่ทำโดย Excel (Data Analysis)

ค่าที่ทำโดยการแบ่งเป็น 2 ส่วน แล้วใช้ Excel (Data Analysis) ที่ล่ะส่วน

ตัวอย่าง 2^4

k	f(t)	Furier Excel คำนวณ	ค่า Fourier Transform แบบแบ่งส่วนคำนวณเอง	IMABS	IMABS
0	3	55	55	55	55
1	3	-8.12340143848118-14.95182856322741	-8.12340143848118-14.95182856322741	17.01608	17.01608
2	4	-1.4142135623731-1.82842712474619i	-1.41421356237309-1.82842712474619i	2.311525	2.311525
3	5	0.131782714245473+1.03979016100833i	0.13178271424547+1.03979016100833i	1.048108	1.048108
4	6	0.999999999999998-2i	0.999999999999993-2i	2.236068	2.236068
5	5	2.11085797287381+0.939285097619991	2.1108579728738+0.939285097619991	2.310406	2.310406
6	6	1.41421356237309-3.82842712474619i	1.41421356237311-3.82842712474618i	4.081281	4.081281
7	4	1.88076075136188+4.9476663733843i	1.88076075136188+4.94766637338431i	5.293077	5.293077
8	4	-1	-1	1	1
9	5	1.88076075136188-4.94766637338431i	1.88076075136188-4.9476663733843i	5.293077	5.293077
10	2	1.4142135623731+3.82842712474619i	1.41421356237309+3.82842712474619i	4.081281	4.081281
11	3	2.1108579728738-0.939285097620002i	2.11085797287381-0.939285097620003i	2.310406	2.310406
12	1	1+2i	1.00000000000001+2i	2.236068	2.236068
13	2	0.131782714245483-1.03979016100833i	0.131782714245481-1.03979016100833i	1.048108	1.048108
14	1	-1.41421356237309+1.82842712474619i	-1.41421356237311+1.82842712474618i	2.311525	2.311525
15	1	-8.12340143848114+14.95182856322741	-8.12340143848114+14.95182856322741	17.01608	17.01608

ค่าที่ทำโดย Excel (Data Analysis)

ค่าที่ทำโดยการแบ่งเป็น 2 ส่วน แล้วใช้ Excel (Data Analysis) ที่ละส่วน

ตัวอย่าง 2^5

k	f(t)	Furier Excel คำนวณ	ค่า Fourier Transform แบบแบ่งส่วนคำนวณเอง	IMABS	IMABS
0	9.423976	130.788080598113	130.788080598113	130.7881	130.7881
1	8.273509	6.16232323114822-8.17900089938816i	6.16232323114823-8.17900089938816i	10.24062	10.24062
2	2.320476	-8.55162489625876-11.6742673966504i	-8.55162489625876-11.6742673966504i	14.47131	14.47131
3	6.826058	12.4855570738088-5.92509601749994i	12.4855570738087-5.92509601749993i	13.82013	13.82013
4	4.774394	15.5543397094586-5.84719014229638i	15.5543397094586-5.8471901422964i	16.61707	16.61707
5	0.271228	10.7882120265182-3.90367286962397i	10.7882120265181-3.90367286962397i	11.47276	11.47276
6	5.258399	-12.1068245498766-8.19520425898973i	-12.1068245498767-8.19520425898977i	14.61973	14.61973
7	7.352485	-3.73923275960692-16.3873857150199i	-3.7392327596068-16.3873857150199i	16.80858	16.80858
8	8.27692	13.7775287431147+12.4369106433738i	13.7775287431147+12.4369106433738i	18.56063	18.56063
9	2.353011	26.6741806918624-17.5278139288958i	26.6741806918624-17.5278139288959i	31.91765	31.91765
10	2.160309	8.72268241650067-14.2774124486234i	8.72268241650073-14.2774124486234i	16.7311	16.7311
11	8.547136	15.0059560482801+6.12813472875795i	15.0059560482802+6.12813472875796i	16.20903	16.20903
12	2.702389	7.33433731268652-18.3240320386486i	7.33433731268666-18.3240320386486i	19.73734	19.73734
13	0.671784	3.50408203670558+1.8523732953865i	3.50408203670558+1.85237329538651i	3.963569	3.963569
14	5.196047	-9.25845999853798+9.02904255300198i	-9.25845999853798+9.02904255300197i	12.93223	12.93223
15	4.100721	-1.75184280606492-3.18588437894818i	-1.75184280606492-3.18588437894819i	3.635768	3.635768
16	0.782822	1.57672433536086	1.57672433536091	1.576724	1.576724
17	2.917618	-1.75184280606491+3.1858843789482i	-1.75184280606491+3.1858843789482i	3.635768	3.635768
18	2.687778	-9.258459998538-9.02904255300198i	-9.258459998538-9.02904255300199i	12.93223	12.93223
19	5.88397	3.50408203670555-1.85237329538649i	3.50408203670555-1.85237329538649i	3.963569	3.963569
20	5.707702	7.33433731268655+18.3240320386486i	7.33433731268659+18.3240320386486i	19.73734	19.73734
21	0.178052	15.0059560482801-6.12813472875799i	15.0059560482801-6.12813472875799i	16.20903	16.20903
22	5.419236	8.7226824165007+14.2774124486234i	8.72268241650073+14.2774124486234i	16.7311	16.7311
23	4.504481	26.6741806918625+17.5278139288958i	26.6741806918624+17.5278139288958i	31.91765	31.91765
24	7.228435	13.7775287431147-12.4369106433738i	13.7775287431147-12.4369106433738i	18.56063	18.56063
25	5.224067	-3.73923275960686+16.3873857150199i	-3.7392327596068+16.3873857150199i	16.80858	16.80858
26	2.813445	-12.1068245498766+8.19520425898975i	-12.1068245498767+8.19520425898976i	14.61973	14.61973
27	0.823287	10.7882120265182+3.90367286962398i	10.7882120265182+3.90367286962396i	11.47276	11.47276
28	1.083328	15.5543397094586+5.84719014229638i	15.5543397094585+5.8471901422964i	16.61707	16.61707
29	6.195115	12.4855570738088+5.92509601749994i	12.4855570738088+5.92509601749993i	13.82013	13.82013
30	0.346747	-8.55162489625874+11.6742673966504i	-8.55162489625874+11.6742673966504i	14.47131	14.47131
31	0.483157	6.16232323114825+8.17900089938819i	6.16232323114824+8.17900089938819i	10.24062	10.24062

ค่าที่ทำโดย Excel (Data Analysis)

ค่าที่ทำโดยการแบ่งเป็น 2 ส่วน แล้วใช้ Excel (Data Analysis) ที่ละส่วน

ตัวอย่าง 2^{12}

k	f(t)	Furier Excel ค่านวณ	ค่า Fourier Transform แบบแบ่งส่วนค่านวณเอง	IMABS	IMABS
0	6.4948	20281.5175222391	20281.5175222391	20281.51752	20281.51752
1	8.251683	-3.72239485173031-87.3891809316789i	-3.7223948517303-87.3891809316788i	87.46842383	87.46842383
2	4.052724	36.1833644592039-181.6012072297l4i	36.1833644592037-181.601207229714i	185.1708247	185.1708247
3	9.287278	-329.106355738608-24.2032047131605i	-329.106355738609-24.2032047131608i	329.9951341	329.9951341
4	3.836184	25.7940845493446+141.004984497246i	25.7940845493455+141.004984497246i	143.3448306	143.3448306
5	3.225992	-298.801266015783-18.2392463773256i	-298.801266015784-18.239246377326i	299.357423	299.357423
6	2.841524	115.938974726319+76.3066377681379i	115.938974726319+76.306637768138i	138.7967897	138.7967897
7	5.398612	133.595869071224-182.438012947992i	133.595869071224-182.438012947992i	226.1227207	226.1227207
8	3.921898	-209.155067415826-14.2566755455701i	-209.155067415826-14.25667554557i	209.6403945	209.6403945
9	5.351066	78.9417588661846+19.0979555300925i	78.9417588661851+19.097955530093i	81.21904455	81.21904455
10	3.58351	-12.5651715978769+44.7801290580902i	-12.5651715978769+44.7801290580902i	46.50960649	46.50960649
11	1.518826	6.4344855493784+218.52340803256i	6.4344855493785+218.52340803256i	218.6181202	218.6181202
12	2.993626	-39.7901452562673-65.0150858443715i	-39.7901452562673-65.0150858443714i	76.22477974	76.22477974
13	5.857563	37.250610794092+42.4498379504897i	37.2506107940921+42.4498379504897i	56.476515	56.476515
4087	0.624165	78.9417588661798-19.0979555300888i	78.9417588661854-19.097955530093i	81.21904455	81.21904455
4088	7.608152	-209.15506741582+14.2566755455723i	-209.155067415826+14.2566755455728i	209.6403945	209.6403945
4089	3.772173	133.595869071221+182.438012947983i	133.595869071227+182.43801294799i	226.1227207	226.1227207
4090	7.720552	115.938974726314-76.3066377681398i	115.938974726319-76.3066377681404i	138.7967897	138.7967897
4091	7.377628	-298.801266015776+18.2392463773324i	-298.801266015781+18.2392463773283i	299.357423	299.357423
4092	4.446382	25.794084549338-141.004984497243i	25.7940845493428-141.004984497245i	143.3448306	143.3448306
4093	4.639216	-329.106355738602+24.2032047131663i	-329.106355738607+24.2032047131629i	329.9951341	329.9951341
4094	7.485609	36.1833644592009+181.601207229713i	36.1833644592036+181.601207229715i	185.1708247	185.1708247
4095	0	-3.72239485173102+87.3891809316775i	-3.72239485172911+87.3891809316786i	87.46842383	87.46842383

ย่อเพื่อให้เห็นข้อมูลช่วงหลัง

ค่าที่ทำโดย Excel (Data Analysis)

ค่าที่ทำโดยการแบ่งเป็น 2 ส่วน แล้วใช้ Excel (Data