Ansys nCode DesignLife

CAE事業部 李易軒 (Denzel)

CAD 於 E 的 和 技 股 份 有 限 公 司







- 內容大綱:
- 1. Ansys nCode Designlife:方案介紹與疲勞理論說明
- 2. ANSYS Mechanical UI 操作介面介紹
- 3. Ansys nCode 獨立介面介紹
- 3.1 應力疲勞分析
- 3.2 載荷事件 (Loading Event) 規劃和累積疲勞損傷
- 3.3 振動疲勞分析
- 4. Fatigue tool vs. nCode Design Life







ANSYS 2022 nCode DesignLife 模組介紹

	Increasing capability	
Ansys nCode DesignLife Enterprise	Seam Weld – Spot Weld - Vibration Fatigue – Thermo-Me Adhesive Bond	echanical Fatigue –
Ansys nCode <i>DesignLife Premium</i>	Full Stress-Life and Strain-Life –Design Life UI Virtual Strain Gauge & Sensor - Material & Vibration Manager - FE Displa Custom Analysis – Signal Processing – Crack Growth Safety Factor – Dang Van – Strain Gauge Positioning	ay
Ansys nCode <i>DesignLife Pro</i>	Limited Stress-Life and Strain-Life Limited Load Handling Accessible via only Mechanical UI	nCode DesignLife





應用產業:

- 車用產品業: 馬達、輪胎、車架疲勞分析
- 電子產品業: 高溫疲勞、隨機振動疲勞、可靠度分析
- 離岸風機業: 輪鼓、夾套焊接處疲勞





Life Type: Life

> 1e + 35 Max 7.526e+31 5.6641e+28 4.2628e+25 3.2082e+22

2.4145e+19 1.8171e+16 1.3676e+13 1.0292e+10









- 用來產生裂紋增長的過程
- 重複施加載重與卸載載重造成結構物破壞之現象
 ▶ 分析疲勞方法分成三種
- Stress-life (*SN*) method
 - ▶ 適用於高週疲勞 (1萬次以上),延性材料
 - ▶ 應力震幅低於降伏點
- Strain-life (EN) method
 - ▶ 適用於高週疲勞 · 低週疲勞
 - ▶ 應變震幅為塑性應變
- Frequensy-based method
 - ▶ 隨機震動,簡諧運動

2 cm

Input

- 1. 應力結果 => 應力分析 (ANSYS, ABAQUS, NASTRAN)
- 2. 疲勞曲線圖 => S-N 曲線 (應力疲勞曲線)、E-N 曲線(應變疲勞曲線)
- 3. 載荷的形式
 - Constant
 - Time Series
 - PSD
 - Temperature

Output

- 1. 損傷
- 2. 壽命
- 3. 熱點分析

- Ansys Mechanical Fatigue tool
 - ➤ Mechanical裡的工具
 - ▶ 用來評估疲勞壽命的分析工具
 - ▶ 適用於SN, EN, Frequency-based 之方法
 - > 支援兩軸疲勞負載施加

- ▶ 只能適用於Static structure, Transient structure, Random vibration, Harmonic response 以上的模組。
- Ansys nCode Design Life
 - ▶與 Ansys Workbench進行介面整合
 - ▶ 豐富的材料庫
 - ▶ 事件疲勞的損傷累積
 - ▶ 支援兩軸以上疲勞負載施加
 - ▶ 高溫疲勞,焊接疲勞,振動疲勞...etc.

nCode

- 1. 減少對打樣測試的依賴,節約設計和時間成本
- 2. 在做物理試驗前,先進行快速的模擬分析
- 3. 降低產品的失效以減少用戶端報修
- 4. 為優化方案提供最佳選擇方案
- 5. 標準化分析流程,以提高一致性品質
- 6. 模擬分析與物理試驗結果直接關聯

nCode DesignLife 是全球領先的**疲勞分析**軟體.系統在產品原型開發完成之前,進行從"有限元分析"到耐久性和認證分析的疲勞壽命預測.

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• Analysis-Domain

- Time Based
- Frequency Based

• Solver

- > SN
- ≻ EN
- Seam Weld
- Loading Event Quick and Easy
 - Constant Amplitude, Time Step, Time Series
 - Import/Export Loading Event
 - PSD

Solution Group

Utilize existing name selection or select geometry on which user wants to review results

• Material

- Material library accessible in Mechanical UI
- nCode Solver
 - > All in background
 - Monitor solution via output window/file
- Post Processing
 - Mechanical way synced with nCode

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D	Details of "Analysis Settings" 👻 🗖 🗖 🗙							
-	Definition							
	Analysis Domain	Time based 🔹						
	Analysis Type	Time based						
	Scale Factor	Frequency based						
	Calculate Safety Factor	No						
	Number of Threads	2						
	Solver Directory	0						
+	Analysis Data Management							

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Definition				
Analysis Domain	Time based			
Analysis Type	Strain Life			
Mean Stress Correction	Strain Life			
MultiAxial Assessment	Stress Life			
Combination Method	Solid Seam Weld			
Elastic-plastic Correction	Neuber			
Scale Factor	1			
Calculate Safety Factor	No			
Number of Threads	2			
Solver Directory	C:\Users\denzel.lee\AppData\Local\Temp.			

Analysis-Domain

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- Frequency Based

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Loading Event – Quick and Easy

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- > PSD

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Definition	
Environment	Harmonic Response
PSD Cycle Counting Method	Lalanne
Table Definition	Tabular Data
Use Static Load Case	Yes
Static Load Case Environment	Static Structural
Static Load Case Step	2

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	⊡ √ S Materials √ Materials → √ Solution	erials Assignment (B6)
D	etails of "Materials Assign	ment" 👓 🔻 🖡 🗖
Ξ	General	
	Based on Material	6061-T6
	Fatigue Type	Stress
	S-N Curve	Tabular Data
	Number of S-N Curves	3
	S-N Curve Definition	R-Ratio
	R-Ratio - Curve 1	-1
	R-Ratio - Curve 2	-0.5
	S-N Curve 2	Tabular Data
	R-Ratio - Curve 3	0
	S-N Curve 3	Tabular Data
	Stress Offset	0 MPa
	Scale Factor	1
	Young's Modulus	68947.57 MPa
	Poisson's Ratio	0.33
	Tensile Ultimate Strength	310.264065 MPa
	nCode Material Type	Aluminum
-	Import S-N Curve	
	Import S-N Curve	Import
	Import S-N Curve Number	1

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C:\Program Files\nCode\ANSYS 2021 R1 nCode DesignLife 64-bit\GlyphWorks\bin\dtproc.exe	-		\times	
218 - 16:01:02 - SetProperty("LoggerFile",Level,"Info") 219 - 16:01:02 - SetProperty("LoggerFile",Overwrite,True) 220 - 16:01:02 - SetProperty("LoggerFile",Format,"Csy") 201 - 16:01:02 - CreateDiae(UTPProfessPile","LogerFice",Del","DraceserFile")			^	•
 221 - 16:01:02 - SetProperty("ProgressFile",Filename, "job, progress") 223 - 16:01:02 - SetProperty("ProgressFile",DeleteOnCompletion,False) 224 - 16:01:02 - CreateObject(DTTImeSeriesFile, "Job", "D:\03 temp\ProjectScratch\Scr1B89\TTT") 225 - 16:01:02 - SetProperty("D:\03 temp\ProjectScratch\Scr1B89\TTT") 	ch\Sci	-1 D 0Ω\T	TT	
225 - 16:01:02 - Set Hoperty(D.Kos_temp() Hopertscharten SetHosyffri ,festhame, D.Kos_temp(_Hopertschart csvi") 226 - 16:01:02 - DoCommand("Job", SetFEResults, Name="FEResultsImport") 227 - 16:01:02 - DoCommand("Job", SetLoadProvider, Name="LoadProviderDutyCycle")		100911		
228 - 16:01:02 - DoCommand("Job", AddLogger, Name="LoggerFile") 229 - 16:01:02 - DoCommand("Job", AddProgress, Name="ProgressFile") 230 - 16:01:02 - DoCommand("Fatigue", AddDefinition, Name="AnaDef_fatigue") 231 - 16:01:02 - DoCommand("AnaDef_fatigue", SetEngine, Name="SNEngine_Fatigue")				
232 – 16:01:02 – DoCommand("AnaDef_fatigue", SetMaterialMap, Name="MaterialMap") 233 – 16:01:02 – DoCommand("Fatigue", AddPostProcessor, Name="Fatigue_Results") 234 – 16:01:02 – DoCommand("SNEngine_Fatigue", SetAbsMaxStressDom, Output="No") 235 – 16:01:02 – DoCommand("LoadProviderDutvCvcle.DutvCvcleItem1", SetLoadProvider. Name=LoadProviderTim	eSerie	es TTT)		
236 - 16:01:02 - DoCommand("LoadProviderDutyCycle.DutyCycleItem2", SetLoadProvider, Name=LoadProviderCon 237 - 16:01:02 - DoCommand("LoadProviderTimeSeries_TTT", SetFBLoadCases, LoadCases="1") 238 - 16:01:02 - DoCommand("LoadProviderTimeSeries_TTT", SetLoadCaseStaticState, Loadcase=1, Static=No), 239 - 16:01:02 - DoCommand("LoadProviderTimeSeries_TTT", SetLoadCaseStaticState, Loadcase=1, Static=No), 230 - 16:01:02 - DoCommand("LoadProviderTimeSeries_TTT", SetLoadCaseStaticState, LoadCaseStaticState, LoadCaseStaticState, LoadCaseStaticState, LoadCaseStaticState, LoadCaseStaticState, LoadCaseStaticState, LoadCaseStaticState, LoadCaseStaticState, LoadCaseState, LoadCaseSta	stant_	CCC)		
240 - 16:01:02 - DoCommand("LoadProviderTimeSeries_TTT", SetDadcaseScaring, Loadcase=1, Scare=1.v, Offs 240 - 16:01:02 - DoCommand("LoadProviderTimeSeries_TTT", SetTimeSeries, Loadcase=1, ChanNum=1, name=D:\C Scratch\Scr1B89\TTT) 241 - 16:01:05 - DoCommand("LoadProviderConstant_CCC", SetFELoadCases, LoadCases="1")	ei=0.0 3_temp	o(_Proj	ect	
242 - 16:01:05 - DoCommand("LoadProviderConstant_CCC", SetLoadCaseScaling, LoadCase=1, MaxFactor=150.000 -150.000000) 243 - 16:01:05 - DoCommand(job,run)	000, b	linFact	or=	

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File Home Solution Information Display S	election Automation MBD for ANSYS Ansys nCode DesignLife
Lupicate Q Outline Solver, Analysis ∉ Remote Point in Cr	ommands @images* omment @Section Plane ant @Annotation Plot Tracker* Plot Tacker*
lutline 👻 🦊 🗖 🗙	Worksheet
Name 👻 Search Outline 🛩 🖕	87,19-Apr-21 16:01:10.864,2,10680,SNEngine_Fatigue,0,Node Id:191. Effective cycle amplitude is greater than UTS 88.19-Apr-21 16:01:10.912.2,10680.SNEngine_Fatigue.0.Node Id:199. May stream is greater than UTS
Contentions Contentions Contentions Contention	(P)(3-Apr-2) 16:0111.125,2)(2006,SIRDging_Tatigue,0,Node Id:246. Effective cycle amplitude is greater than UTS (0)(3-Apr-2) 16:0111.267,2)(2006,SIRDging_Tatigue,0,Node Id:251. Max stress is greater than UTS (2)(3-Apr-2) 16:0111.267,2)(2006,SIRDging_Tatigue,0,Node Id:254. Effective cycle amplitude is greater than UTS (3)(3-Apr-2) 16:0111.267,2)(2006,SIRDging_Tatigue,0,Node Id:264. Effective cycle amplitude is greater than UTS (4)(3-Apr-2) 16:0111.267,2)(2006,SIRDging_Tatigue,0,Node Id:264. Effective cycle amplitude is greater than UTS (4)(3-Apr-2) 16:0111.267,2)(2006,SIRDging_Tatigue,0,Node Id:264. Effective cycle amplitude is greater than UTS (4)(3-Apr-2) 16:0111.1367,2)(2006,SIRDging_Tatigue,0,Node Id:264. Effective cycle amplitude is greater than UTS (4)(3-Apr-2) 16:0111.1367,2)(2006,SIRDging_Tatigue,0,Node Id:264. Effective cycle amplitude is greater than UTS (4)(3-Apr-2) 16:0111.1567,2)(2006,SIRDging_Tatigue,0,Node Id:274. Max stress is greater than UTS (4)(3-Apr-2) 16:0111.1607,2)(2006,SIRDging_Tatigue,0,Node Id:312. Effective cycle amplitude is greater than UTS (0)(1)(3-Apr-2) 16:0111.607,2)(2006,SIRDging_Tatigue,0,Node Id:312. Effective cycle amplitude is greater than UTS (0)(1)(3-Apr-2) 16:0111.607,2)(2006,SIRDging_Tatigue,0,Node Id:313. Effective cycle amplitude is greater than UTS (0)(1)(3-Apr-2) 16:0111.607,2)(2006,SIRDging_Tatigue,0,Node Id:313. Effective cycle amplitude is greater than UTS (0)(1)(3-Apr-2) 16:0111.607,2)(2006,SIRDging_Tatigue,0,Node Id:313. Effective cycle amplitude is greater than UTS (0)(1)(3-Apr-2) 16:0111.607,2)(2006,SIRDging_Tatigue,0,Node Id:314. Max stress is greater than UTS (0)(1)(3-Apr-2) 16:0111.607,2)(2006,SIRDging_Tatigue,0,Node Id:315. Max stress is greater than UTS (0)(1)(3-Apr-2) 16:0111.607,2)(2006,SIRDging_Tatigue,0,Node Id:315. Max stress is greater than UTS (0)(1)(3-Apr-2) 16:0111.784,2)(2006,SIRDging_Tatigue,0,Node Id:315. Max stress is greater than UTS (0)(1)(3-Apr-2) 16:0111.784,2)(2006,SIRDging_Tatigue,0,Node Id:316, Max stress is greater than UTS (0)(1)(3

Analysis-Domain

- Time Based
- Frequency Based

• Solver

- > SN
- > EN
- Seam Weld
- Loading Event Quick and Easy
 - Constant Amplitude, Time Step, Time Series
 - Import/Export Loading Event
 - PSD

Solution Group

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KID Life

案例分析-問題描述

@2022 ANSYS,Inc.

Time: 1. s

• 鋁合金應力(S-N)曲線圖 (Muti-R ratio)

Mean Stress Correction: Goodmen

@2022 ANSYS,Inc.

•載荷類型

- 疲勞壽命分析結果
- 結論:

根據測試規範,曲柄於此規範下必須能夠承受10萬次的循環 載荷而不能有任何破損,最嚴重的位置可以承受22萬次的壽命,因此符合規範。

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Static analysis_Linear/Non-linear

D nCode WeldShellSeam (DesignLife)

D nCode WeldSolidSeam (DesignLife)

Temperature stress analysis_Linear/Non-linear

Dynamic analysis_Frequency domain_Linear

Dynamic analysis_Time domain Linear/Non-Linear

案例分析-問題描述

Ansys

- 目標:
 - 利用SN曲線計算越野自行車車架在恆定振幅 (0-3 G)下的負載,並且 評估其壽命和熱點。
- 步驟
 - 匯入應力結果檔
 - 設定振幅載重
 - 進行疲勞壽命與損傷的後處理
 - 加入熱點偵測·抓出前10個疲勞損傷較高的區域

• 找尋特定點的疲勞損傷或是壽命

DataValuesDisplay2	DataValuesDisplay2										
Export	Сору										
	1	2	3	4	5	6	7	8	9	10	
Remove Sort	Node	Shell layer	Material Group	Property ID	Material ID	Damage	Mean biaxiality	Non-proportion	Dominant stres	Life	
									degrees	Repeats	
1	4104	Тор	All entities	2	4	2.27e-07	0.0242	0	-9.39	4.406e+06	
2	4142	Bottom	All entities	2	4	1.399e-07	0.05487	0	28.74	7.147e+06	
3	4104	Bottom	All entities	2	4	1.205e-07	0.1362	0	-7.271	8.3e+06	
4	4142	Тор	All entities	2	4	1.122e-07	0.05214	0	24.81	8.916e+06	
5	4105	Тор	All entities	2	4	5.469e-08	-0.02344	0	-36.4	1.829e+07	
6	4105	Bottom	All entities	2	4	1.056e-08	0.148	0	-36.01	9.469e+07	
7	4138	Тор	All entities	2	4	6.15e-09	0.1119	0	10.75	1.626e+08	
8	77	Bottom	All entities	2	4	5.035e-09	0.7124	0	84.2	1.986e+08	
9	92	Bottom	All entities	2	4	4.411e-09	0.4133	0	80.6	2.267e+08	

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nCode 支援多軸載荷

CADMEN

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- 分析多個事件並將結果組合的過程,以工作週期或耐用性時間表來表示。
- Event_A.rsp
- Event_B.rsp
- Event_C.rsp

✔ 實駕路測 → 收集訊號資料 → 重新產生輸入資料

nCode DesignLif	fe									
Main Menu	File Edit View Insert Inte	eractive Run Workspace	Help							
Applications	🗋 🗳 📙 🐼 🔊	👆 🖻 🛍 🖌 🙆 🤇	à 🗟 🕸 📫 🖄 🍜 🕨 🕷)						
	Wa New to DesignLife?	atch a video							?	×
ASCIITranslate	New to DesignLife? Wa	atch a video ← ☞ ScheduleCreate Setup Type Channel Matching Pad Missing Channel Join Type Join Time Taper Type Taper Time Channel Mapping Sample Rate X-Axis Label	CAE Duty Cycle Number × Chann s None 1 None 1	? ×	 ← ScheduleCreate Events Description 1 Event_A 2 Event_B 3 Event_C 	Type Time Series Time Series Time Series	Configuration d:\03_temp\08_DutyCycleAnalys d:\03_temp\08_DutyCycleAnalys d:\03_temp\08_DutyCycleAnalys	Add Ev Repeats 80 120 5 5	? ents Rem Active ✓	× ove Event
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			3 Next	Cancel Help			Ne	xt C	Cancel	<u>H</u> elp

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Result for cycle loading

	Indeper	ndent	Combin	edFast	CombinedFull			
	Damage	Life	Damage	Life	Damage	Life		
Event_A	0.01156	86.48	0.01162	86.09	0.01162	86.06		
Event_B	0.02557	39.1	0.0249	40.15	0.02566	38.97		
Event_C	0.005377	186	0.005351	186.9	0.005349	187		
ALL	0.04251	23.52	0.04187	23.88	0.04263	23.46		

Ncode可以支援當機器經歷了Event A、Event B, 和Event C之後所累積的損 傷。上圖呈現使用不同的方法,用來計算事件與事件之間的疲勞損傷。

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Base Excitation Acceleration Loading

A: Model, Harmonic Response

Adding DesignLife System for Vibration Fatigue

• 振動疲勞分析

Defining the Inputs and Analysis

• 滑鼠右鍵,定義輸入

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• Loading : Vibration

Vibration_Analysis 0 Messages Show	Y Z_X	
•	Disconnect Cut Copy	Ctrl+X Ctrl+C
Ay XY Display In 1 Ch 1 : Vibration Generator Channel : RMS Power	Delete Rename	Del Ctrl+F2
	Bring to Front Send to Back	
stress_PSD XY Display	Save As Edit Material Mapping Edit Load Mapping Advanced Edit Edit Exposed Properties	
	User form configuration Glyph permissions Property permissions	
	Properties	

🖬 Edit Load Map (VibrationLoad)								×
Edit Loading Advanced								
Loading Type: Vibration								
Load Case Descriptions: All								
Modal FRF Static Temperature								
Available FRF Load Cases	FRF Load Ca	se Assignments				View Pro	operties	
Description	Load Case	Description	Histogram/MC	Chan	Chan Title			
1 - vib_modelHarmonic Response (A5):Stress	1	1 - vib_modelHarmonic R	HistogramPipe1	1	Vibration G	enerator	Channel	
Available Loads (drag onto FRF load case above)						A	> xdd	
 HistogramPipe1 1 - Vibration Generator Channel 								
					ОК С	ancel	Hel	р

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- 內容大綱:
- 1. Ansys nCode Designlife:方案介紹與疲勞理論說明
- 2. ANSYS Mechanical UI 操作介面介紹
- 3. Ansys nCode 獨立介面介紹
- 3.1 應力疲勞分析
- 3.2 載荷事件 (Loading Event) 規劃和累積疲勞損傷
- 3.3 振動疲勞分析
- 4. Fatigue tool vs. nCode Design Life

Fatigue tool V.S Ncode design life

疲勞負載以及功能	Ansys fatigue tool	Ncode
靜態SN,EN	\checkmark	\checkmark
線性動態疲勞	\checkmark	\checkmark
雙軸疲勞	\checkmark	\checkmark
多軸疲勞		\checkmark
非比例時域加載		\checkmark
平均應力/應變校正	\checkmark	\checkmark
事件累積損傷		\checkmark
焊縫疲勞		\checkmark
裂縫成長		\checkmark
溫度疲勞		\checkmark
缺口效應		\checkmark
熱點偵測		\checkmark

謝謝!

