坊中橋の部分的腐朽が固有振動数に与える感度　7021591　永山大智

橋梁の維持管理は重要

目視・打音検査　→　危険・労力を伴う、劣化の数値的な評価が難しい

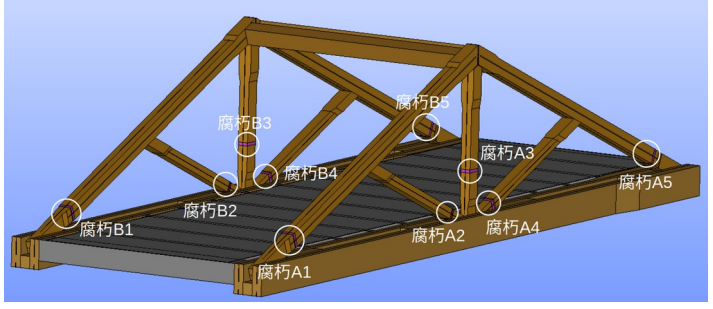
振動試験　→　比較的安全、劣化の数値的な評価が可能

固有振動数

〈本研究〉

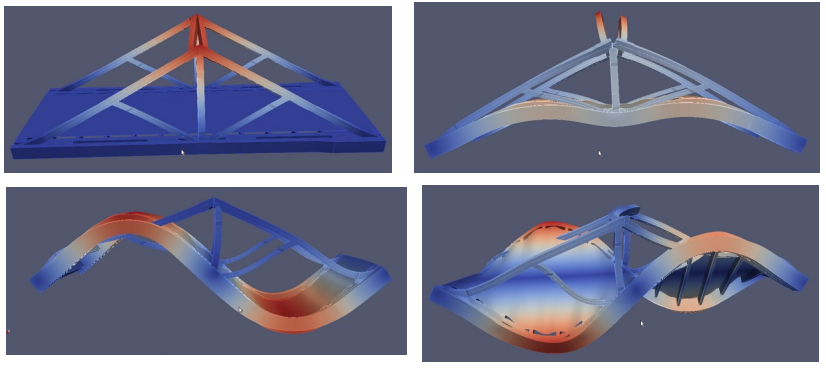
坊中橋

作成



腐朽による全体の
固有振動数への影響を
感度解析から調べる！

腐朽箇所を
作って解析



解析モデル

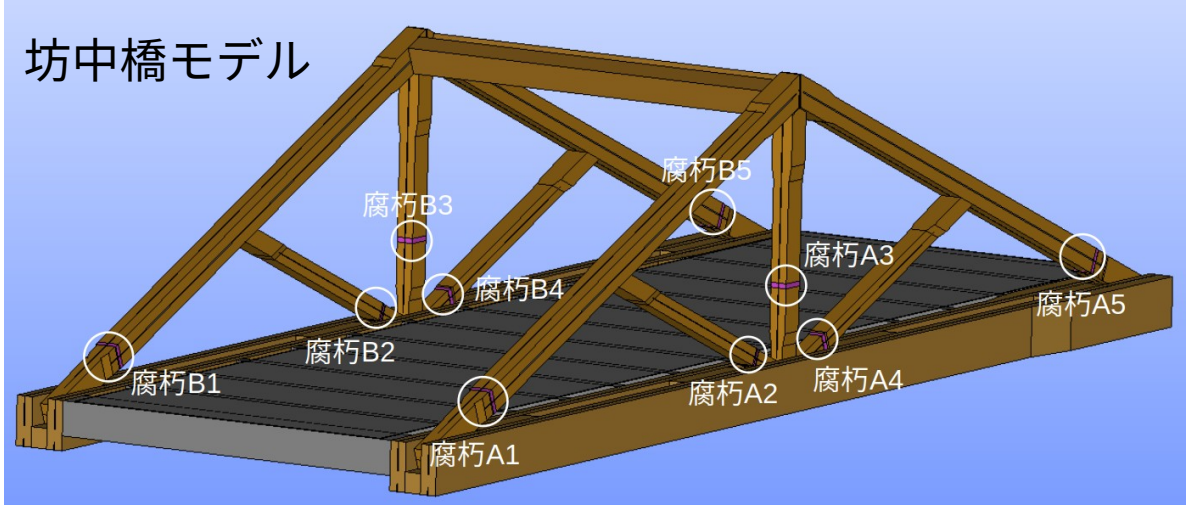
坊中橋

形式：キングポストトラス橋

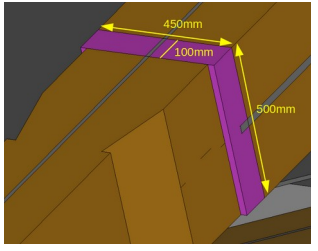
桁長：54.8m　支間長：27m　有効幅員：9m

使用材料：スギ集成材

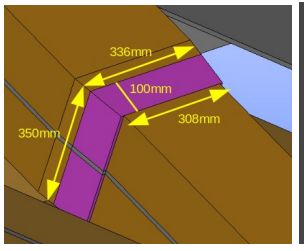
Salome-Mecaで３Dモデル化



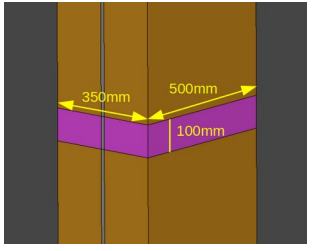
厚さ100mmの腐朽箇所を作成



A1,A5,B1,B5



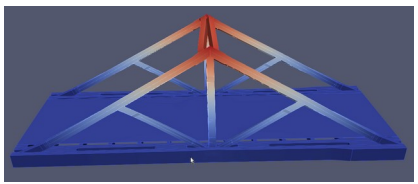
A2,A4,B2,B4

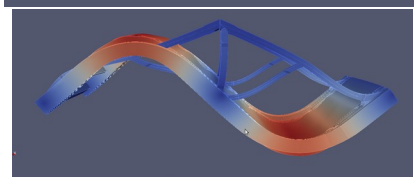


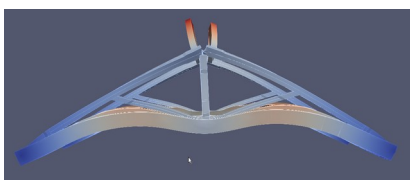
A3,B3

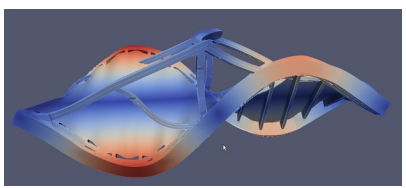
モデルの妥当性を検証

架設当初の振動試験による測定値(草薙2003)と
健全時のモデルの振動解析による解析値から相対誤差を算出





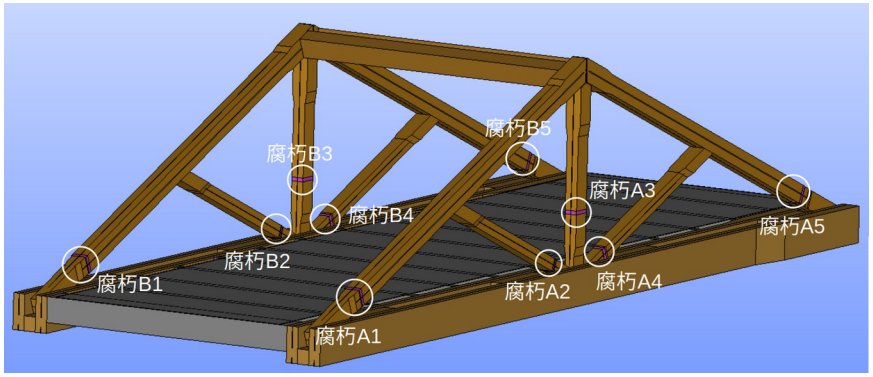




	測定値	解析値	相対誤差
水平対称1次	2.54Hz	2.53Hz	-0.39%
鉛直逆対称1次	4.39Hz	4.41Hz	0.45%
鉛直対称1次	4.88Hz	4.22Hz	-13.52%
ねじれ逆対称1次	8.01Hz	9.03Hz	12.73%

解析方法

腐朽箇所と振動モードごとにグラフを作成

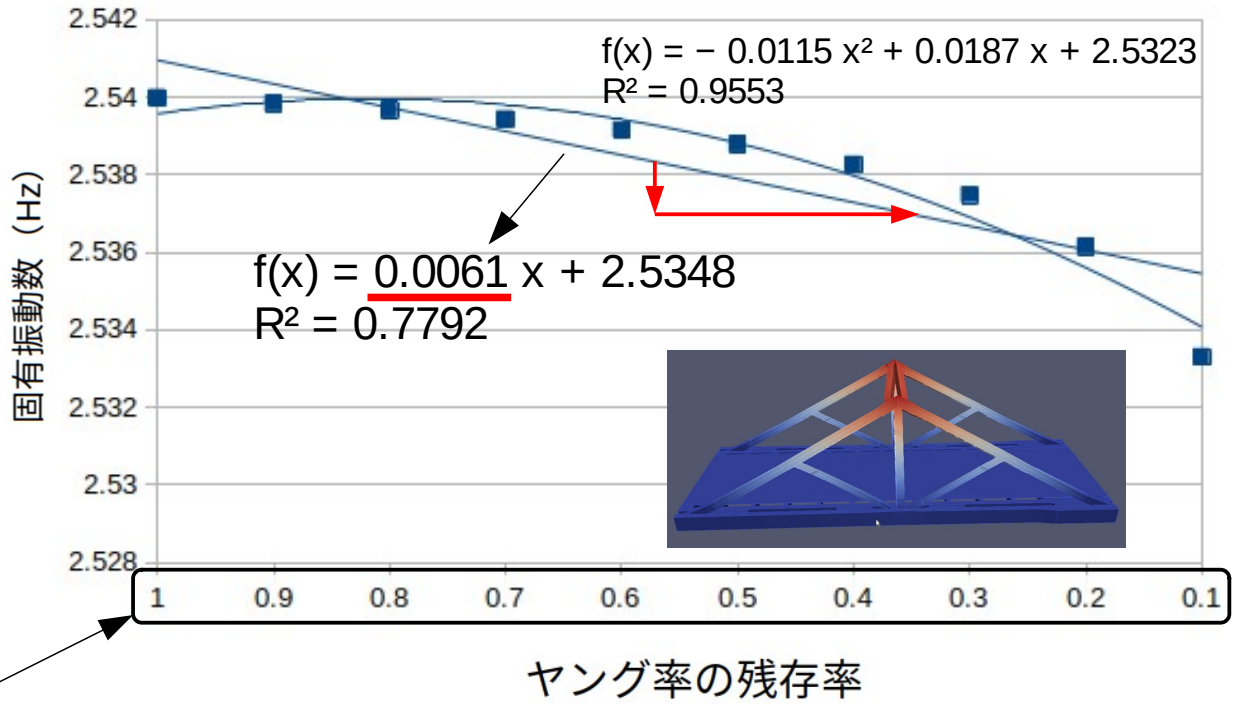


10個の腐朽箇所を

１箇所ずつ段階的に腐朽させる

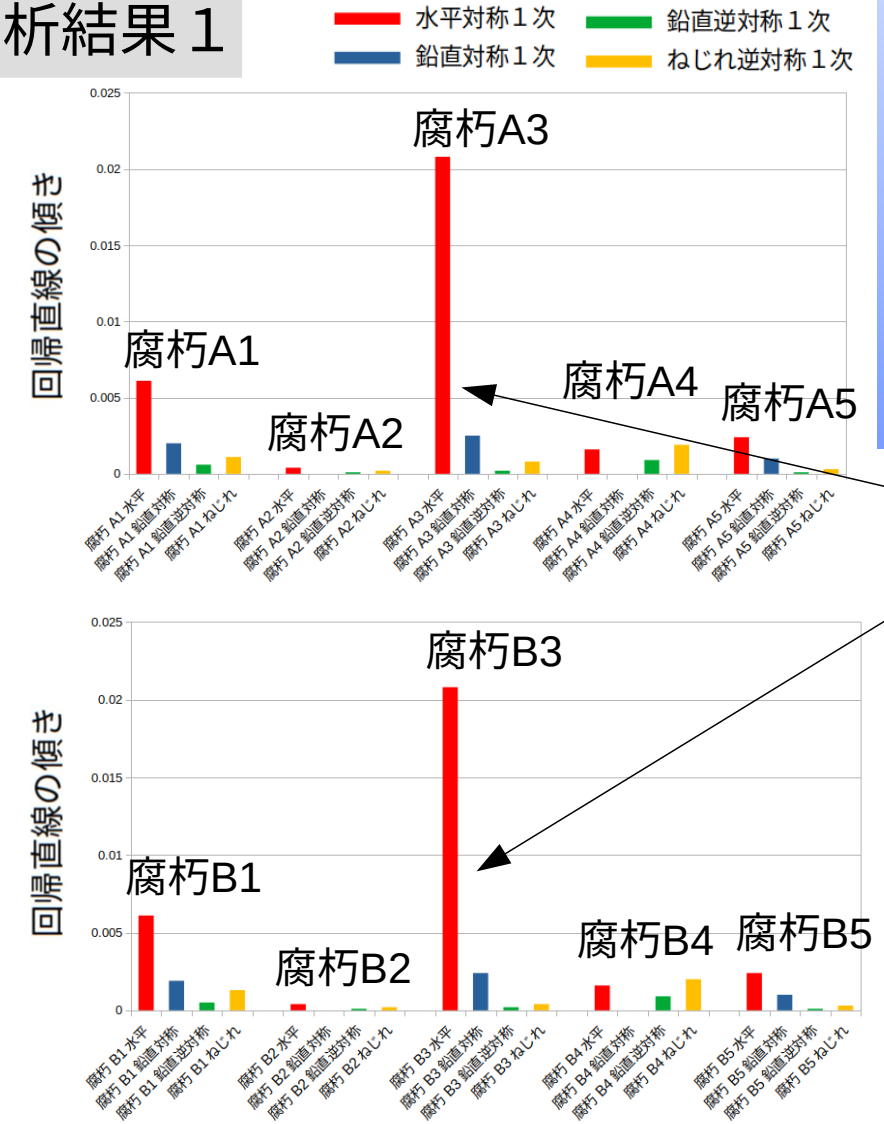
健全時のヤング率から
１倍、0.9倍、…、0.2倍、0.1倍
の10段階で腐朽を再現

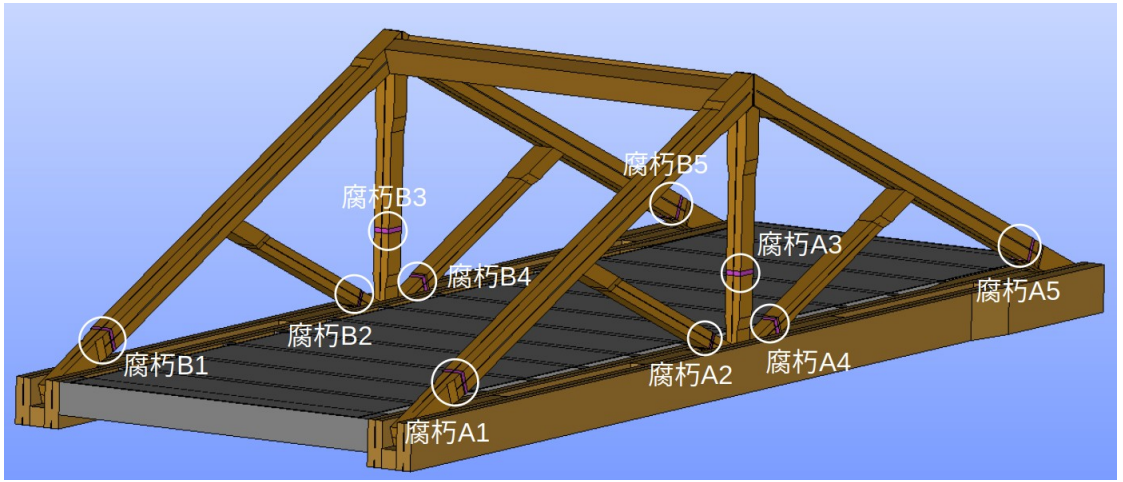
腐朽A1が腐朽時の**水平対称１次モード**のグラフ



回帰直線の傾き
を感度とする

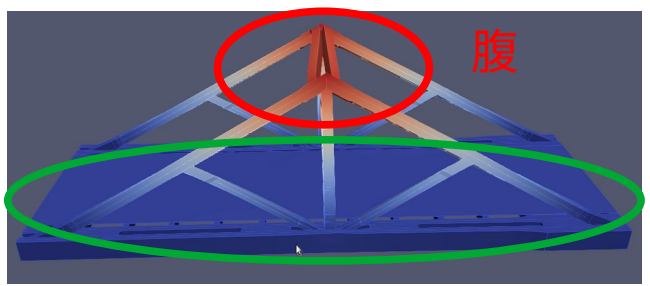
解析結果１





垂直材の水平振動の感度が高い

水平振動において**振動の腹**に近いから

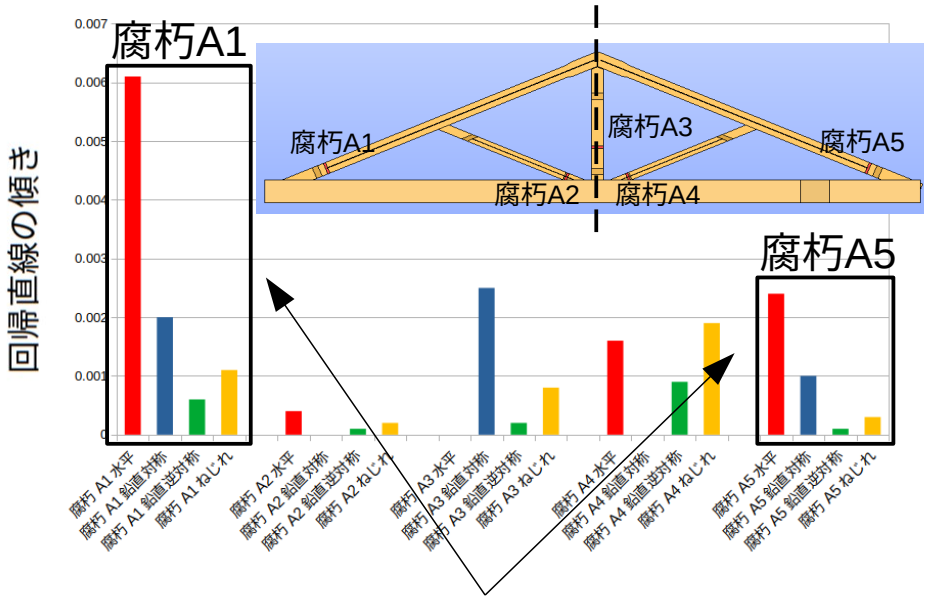


水平対称1次モード

解析結果２

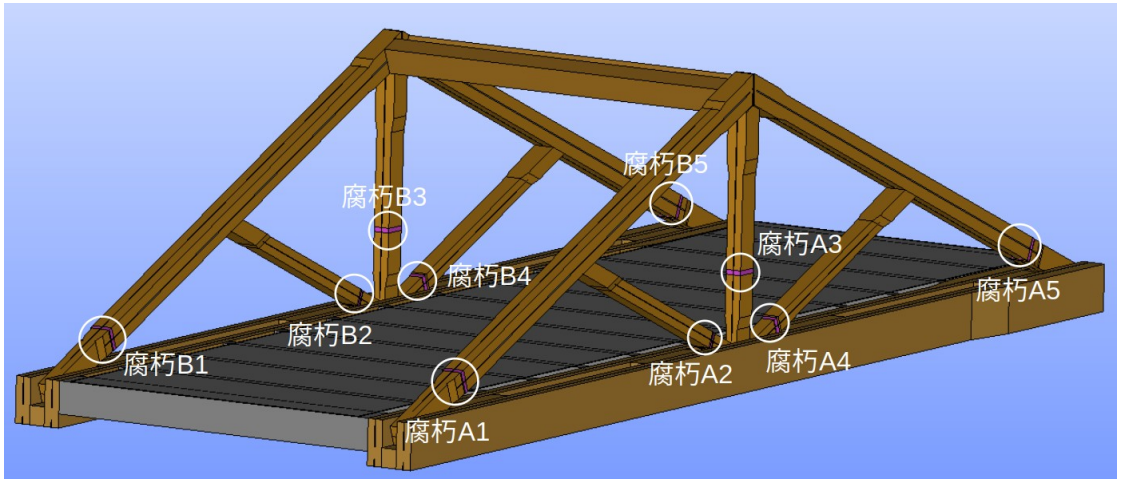
水平対称１次　鉛直逆対称１次
鉛直対称１次　ねじれ逆対称１次

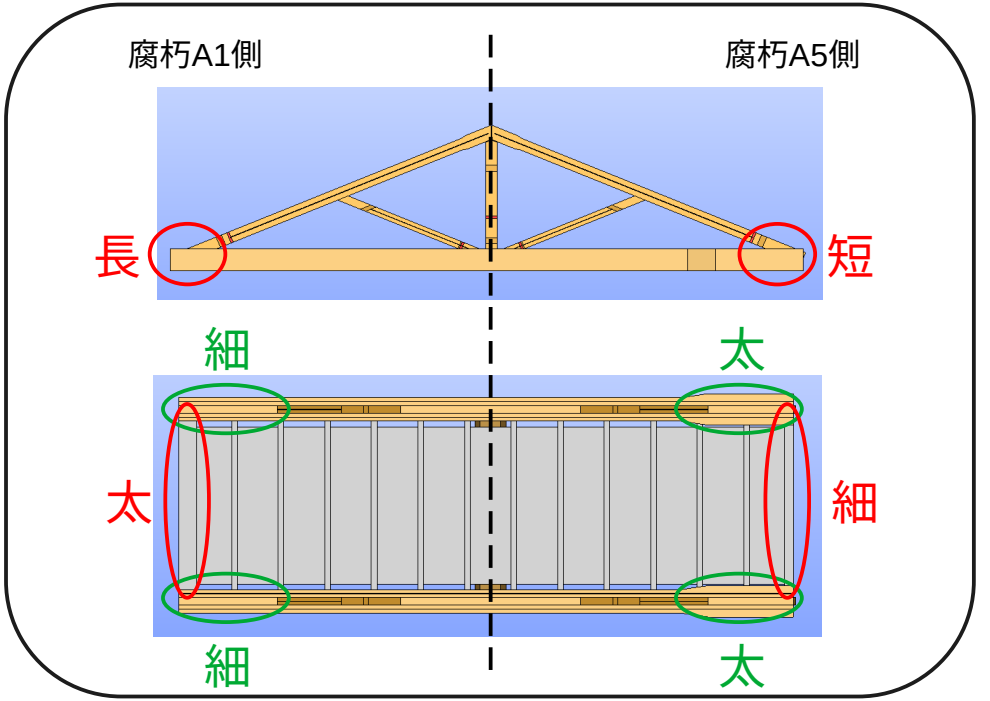
垂直材の水平振動の感度を取り除くと...



対称な位置の感度に大きな差

坊中橋モデルの**非対称性**が原因？

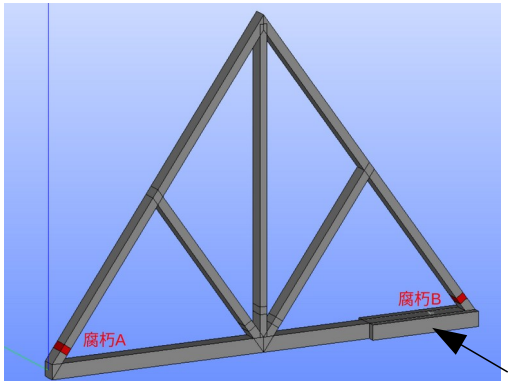




非対称性による感度への影響

両モデルとも坊中橋モデルと同じ方法で感度を算出

簡易トラスモデル

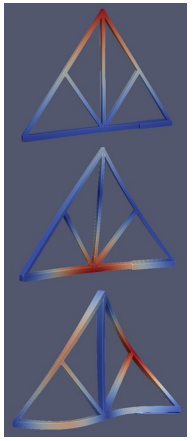


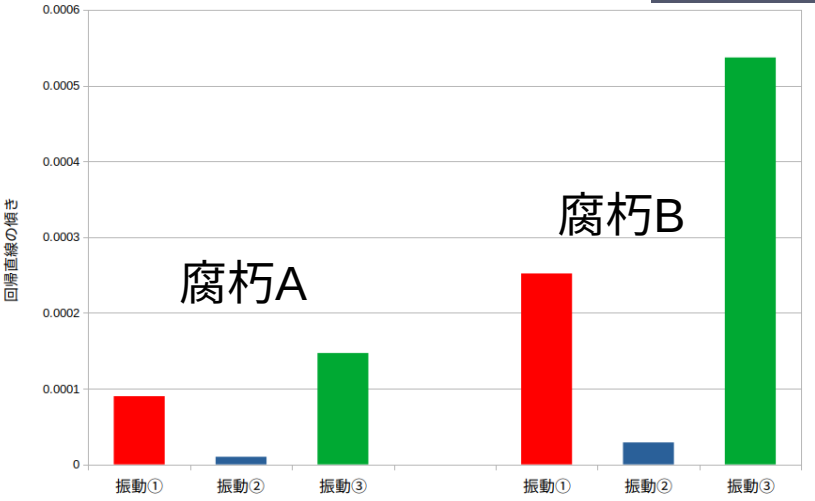
太

振動①

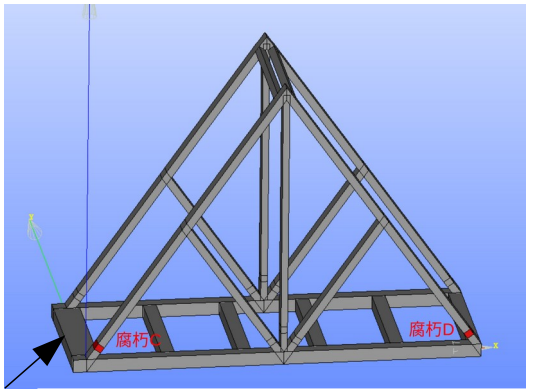
振動②

振動③





簡易橋梁モデル

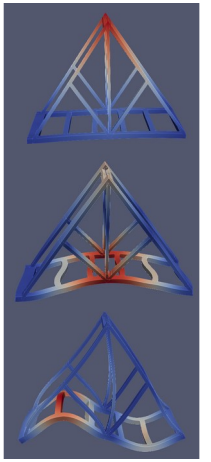


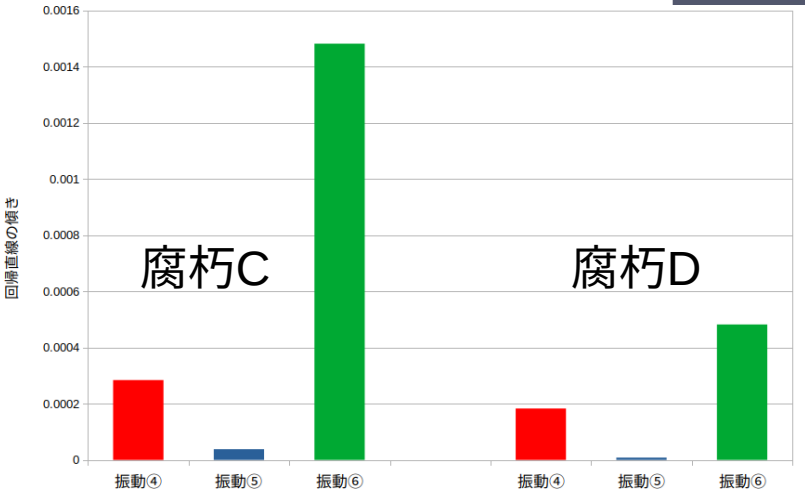
太

振動④

振動⑤

振動⑥

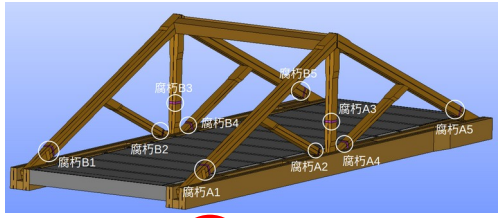




剛性が高い方の感度が高くなる

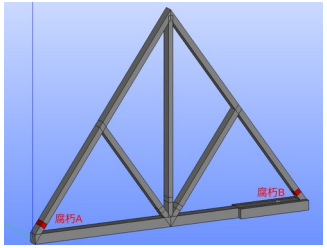
まとめ

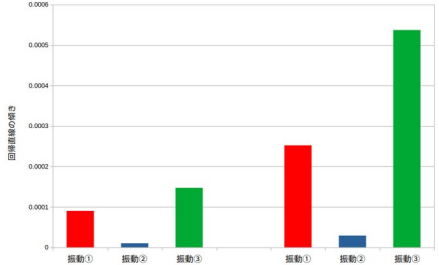
坊中橋モデルを作成

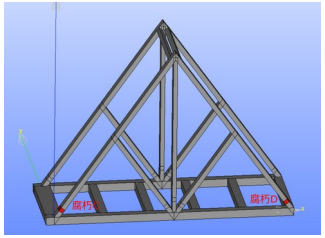


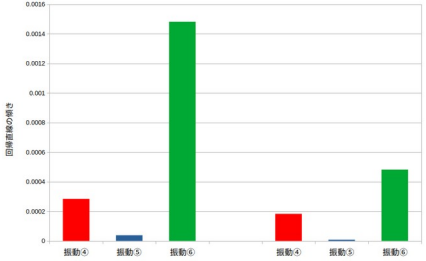
相対誤差を算出 → 精度 高

非対称性による影響



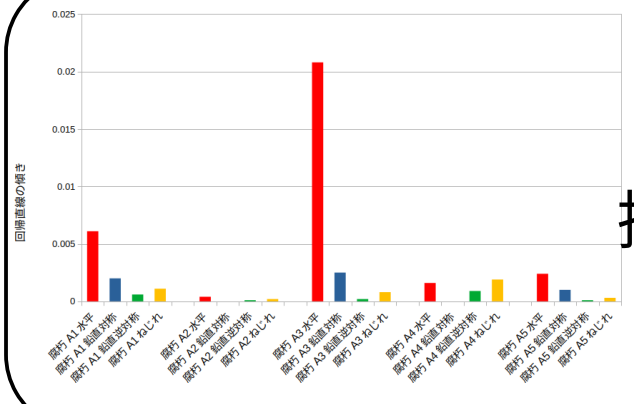






剛性が高い方の感度が高い

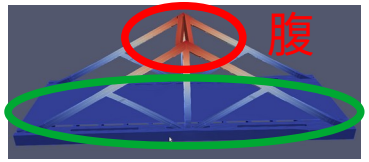
感度解析

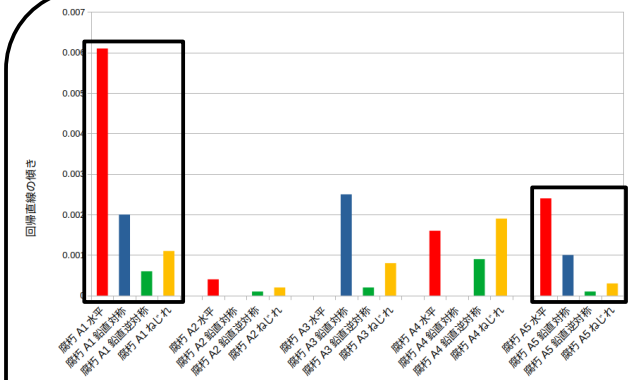


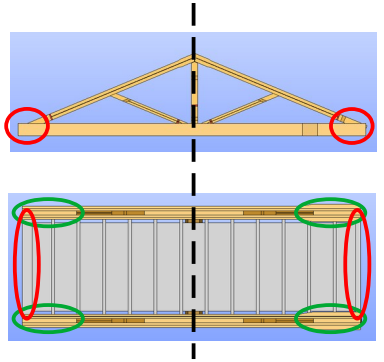
垂直材の水平振動の感度が高い

↓

振動の腹に近いから





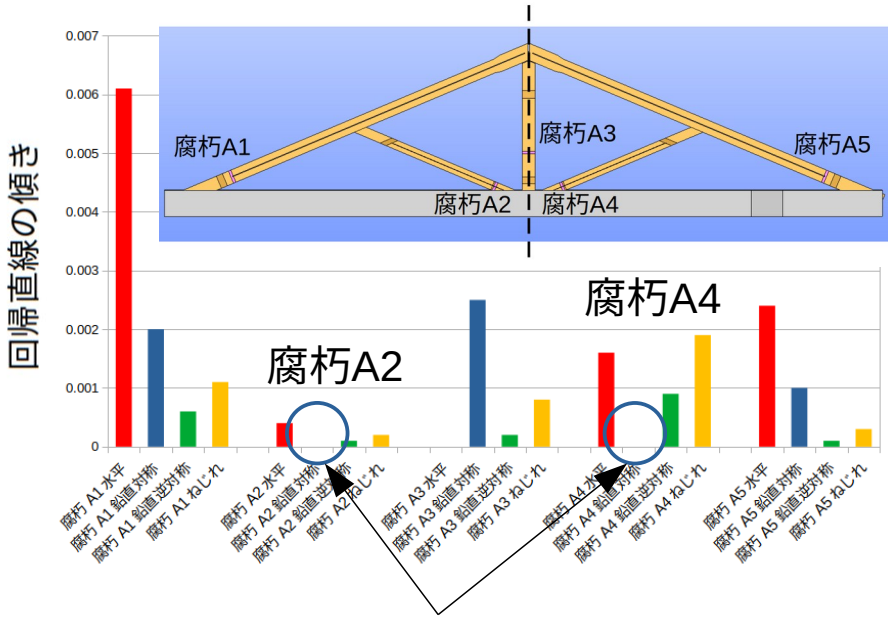


対称な位置の感度に差 → モデルの非対称性

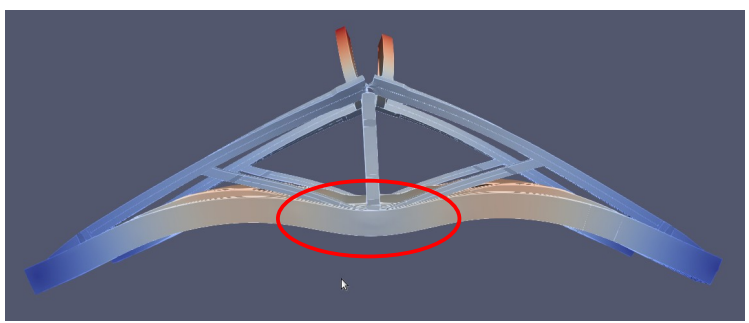
今後の課題

非対称性と感度の具体的な関係を調べる

A2とA4の感度について

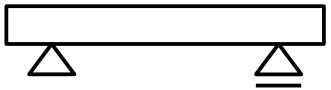


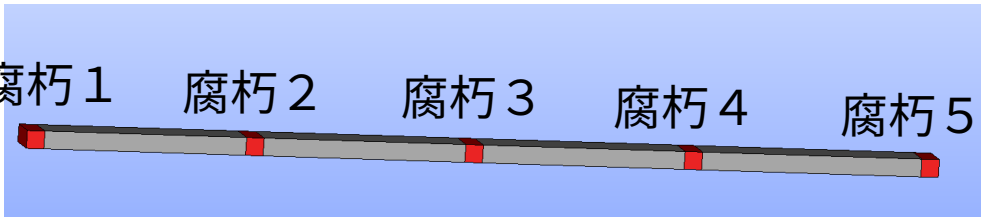
A2とA4の鉛直対称の感度が低い

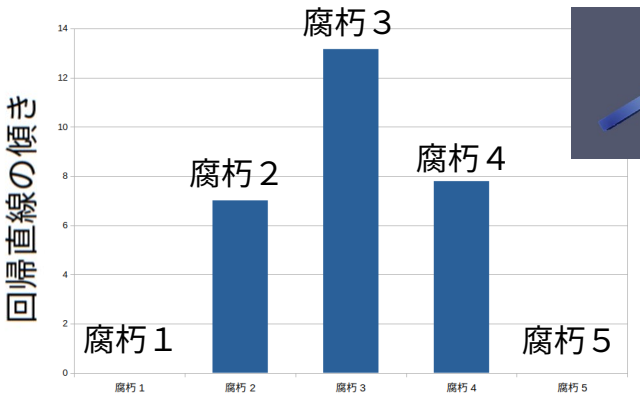


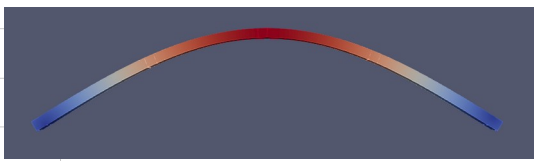
垂直材によって
桁の中央付近が
固定されてるため

簡易的な単純梁モデルだと...



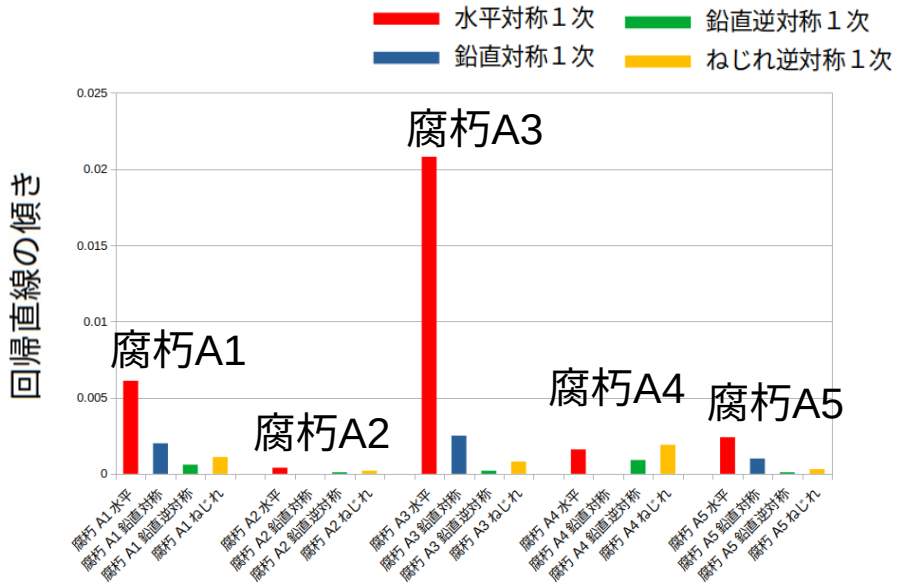


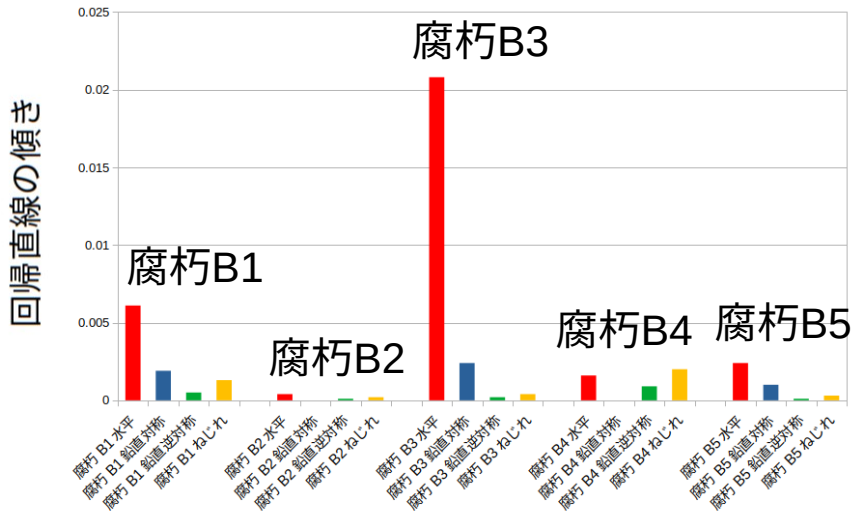


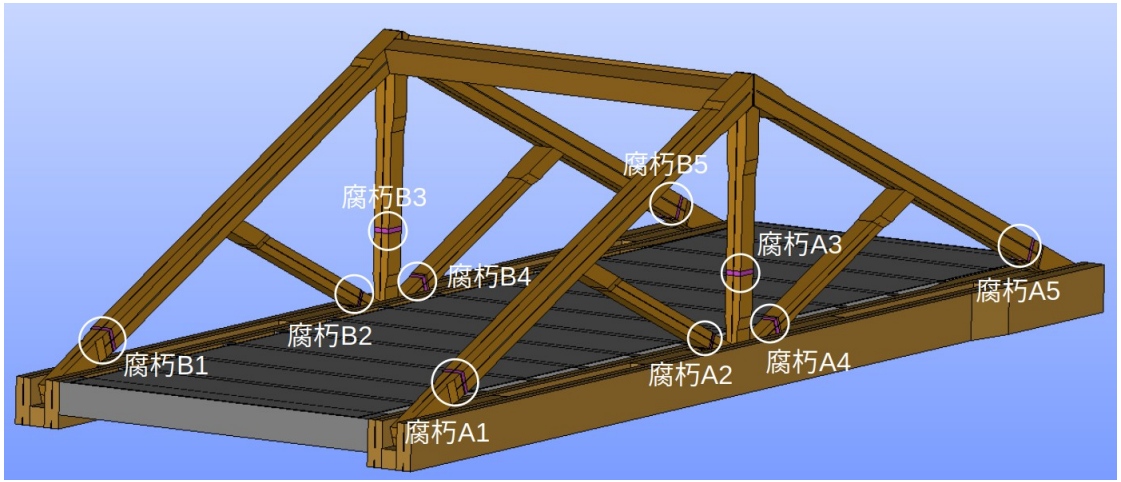


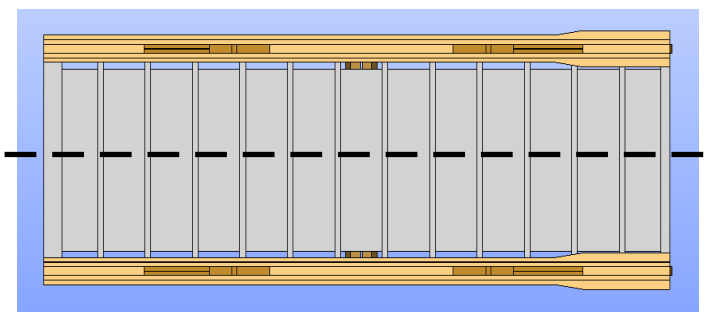
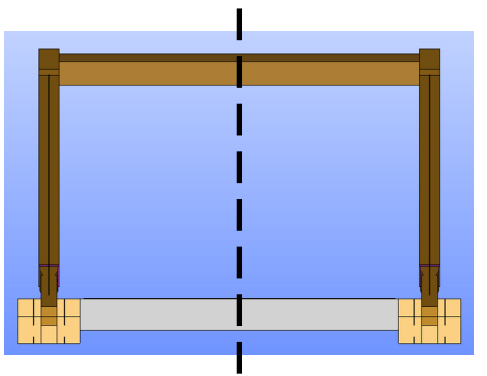
中央の感度は高く、
端部は低い

キングポストトラス
固有の傾向







２つの棒グラフがほぼ同じ形になった理由

坊中橋モデルは幅員方向で対称だから