# NASA Rotor 67

- Français
- English

This page contains various informations associated to one of the rotor 67 blade model used in LAVA publications.

Downloadable files

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**Open access**

**Git project**

## Original model

- Original technical report [1]:

```
@TechReport{urasek1979design,
author      = {Urasek, D. C. and Gorrell, W. T. and Cunnan, W. S.},
title       = {Performance of two-stage fan having low-aspect-ratio first-
stage rotor blading},
institution = {NASA Lewis Research Center Cleveland, OH, United States},
note        = {NASA-TP-1493, url~:
\url{https://ntrs.nasa.gov/citations/19790018972}, 1979 (accessed
2021-09-09)}}
```

- Pictures :

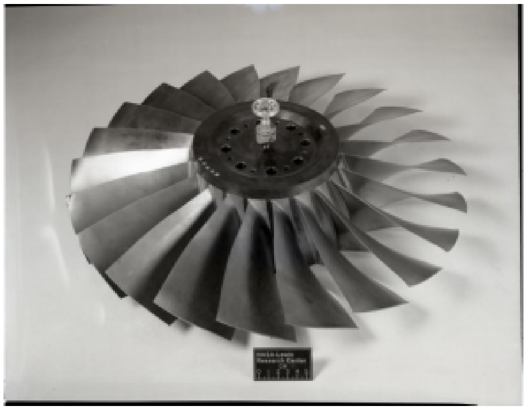


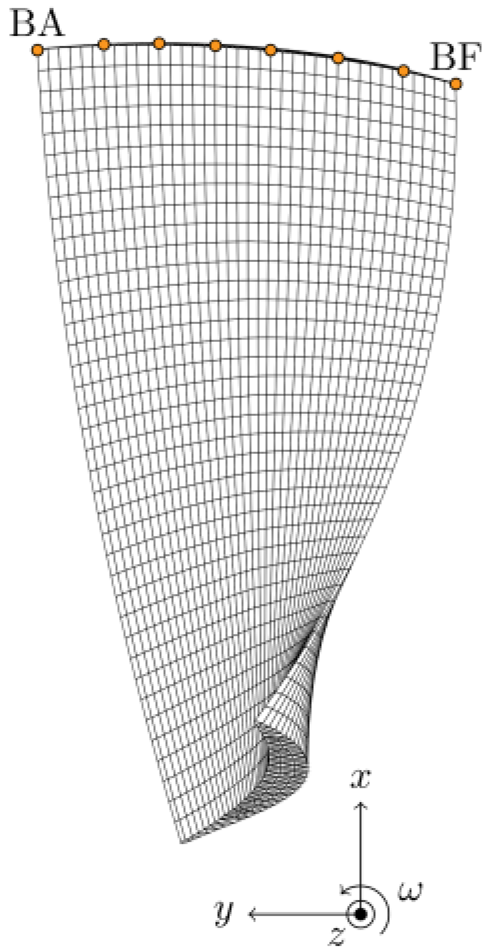
Fig 1. https://catalog.archives.gov/id/17500553

Fig 2. https://catalog.archives.gov/id/17500556

```
@Misc{huebler1977records,
author   = {Laity, D.},
title    = {Stage 67 rotor and stage 67 casing half stators mounted.
{R}ecords of the {N}ational {A}eronautics and {S}pace {A}dministration,
1903 - 2006. {P}hotographs relating to agency activities, facilities and
personnel, 1973 - 2013},
note     =
{\href{https://catalog.archives.gov/id/17500553}{https://catalog.archives.
gov/id/17500553}, 1980 (accessed 2021-09-09)}, % Fig 1
note     =
{\href{https://catalog.archives.gov/id/17500556}{https://catalog.archives.
gov/id/17500556}, 1980 (accessed 2021-09-09)}, % Fig 2
}
```

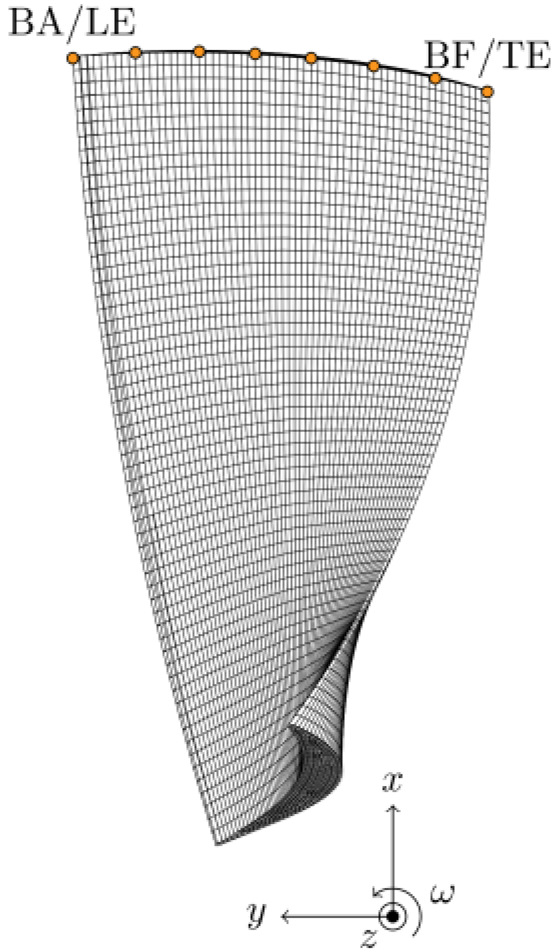
# Finite element mesh

- Number of nodes: 20393
- Total number of elements: 6232
- Number of degrees of freedom: 59964
- Element type: quadratic pentahedron




finite element mesh overview (coarse mesh) - LaTeX source files

- Number of nodes: 83393
- Total number of elements: 28560
- Number of degrees of freedom: 246960
- Element type: quadratic pentahedron




finite element mesh overview (refined mesh) - LaTeX source files

# Material properties

- The original material of the rotor 67 is not defined in the NASA report
- Considered properties: Ti-6Al-4V, generic titanium:
    1. Young's modulus E = 108 GPa
    2. density$\rho$ = 4400 kg/m3
    3. Poisson's ratio $\nu$ = 0.34
    4. yield stress $\sigma_Y$ = 0.824 GPa
- First three predicted natural frequencies (with clamped root) for the coarse mesh:
    1. 1B: 2040.7 rad/s / 324.8 Hz
    2. 2B: 6345.9 rad/s / 1010.0 Hz
    3. 1T: 10734.6 rad/s / 1708.5 Hz
- First three predicted natural frequencies (with clamped root) for the refined mesh:
    1. 1B: 2039.7 rad/s / 324.6 Hz
    2. 2B: 6340.6 rad/s / 1009.1 Hz
    3. 1T: 10735.0 rad/s / 1708.5 Hz

# Featured references from the LAVA

- *Stratégie numérique pour l’analyse qualitative des interactions aube/carter* [2] BibTex
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```
  @Article{colaitis2021thesis,
  author   = {Cola\"{i}tis, Y.},
  title    = {{Stratégie numérique pour l’analyse qualitative des
interactions aube/carter}},
  year     = {2021},
  note     = {\href{https://tel.archives-ouvertes.fr/tel-03318777}{oai:
tel-03318777}},
  abstract = {This thesis introduces a frequency-domain numerical
methodology based on the harmonic balance method coupled to a predictor-
corrector continuation algorithm for the qualitative analysis of blade-
tip/casing contacts in aircraft engines. Unilateral contact and dry
friction are taken into account through a regularized penalty law. In
order to enhance the robustness of the methodology, attention is paid to
the mitigation of the Gibbs phenomenon. To this end, the employed
alternating frequency/time scheme features a Lanczos filtering so that
spurious oscillations of the computed nonlinear contact forces become
negligible. The proposed methodology is shown to be fully compatible with
the numerical models used for existing industrial time integration
strategies. The proposed numerical methodology is combined with a model
reduction technique on several industrial blades (compressor and fan) as
well as on a full 21-blades bladed disk. In order to assess the influence
of both contact law regularization and Lanczos filtering, obtained results
are thoroughly compared to an existing, state-of-the-art, time
integration-based numerical strategy relying on a Lagrange multiplier-
based approach for contact treatment that was previously confronted to
experimental results. The presented results underline the very good
agreement between the proposed methodology and the reference time
integration numerical strategy. A local stability analysis of the computed
solutions is also performed thanks to Floquet theory by means of both
monodromy matrix computation and Hill's determinant solution. These
results thus complement existing time integration-based results on blade-
tip/casing contact, providing a much needed qualitative understanding of
the interaction and an accurate estimation of the nonlinear resonance
frequency. }}
```

Cette page contient diverses informations associées à l'un des modèles de l'aube NASA rotor 67 utilisé dans les publications du LAVA.

Fichiers téléchargeables

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**Libre accès**

**lien vers le projet Git**

# Modèle original

- Rapport technique original [1]:

```
@TechReport{urasek1979design,
author      = {Urasek, D. C. and Gorrell, W. T. and Cunnan, W. S.},
title       = {Performance of two-stage fan having low-aspect-ratio first-
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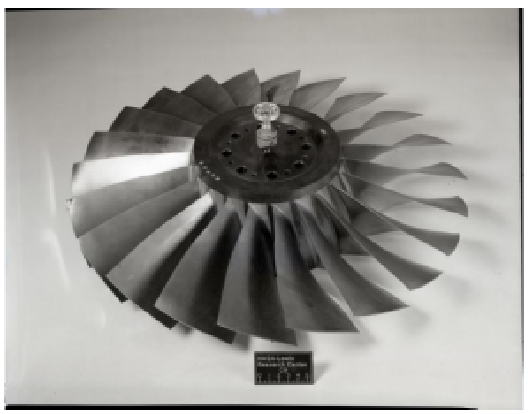
- Photographies :



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1903 - 2006. {P}hotographs relating to agency activities, facilities and
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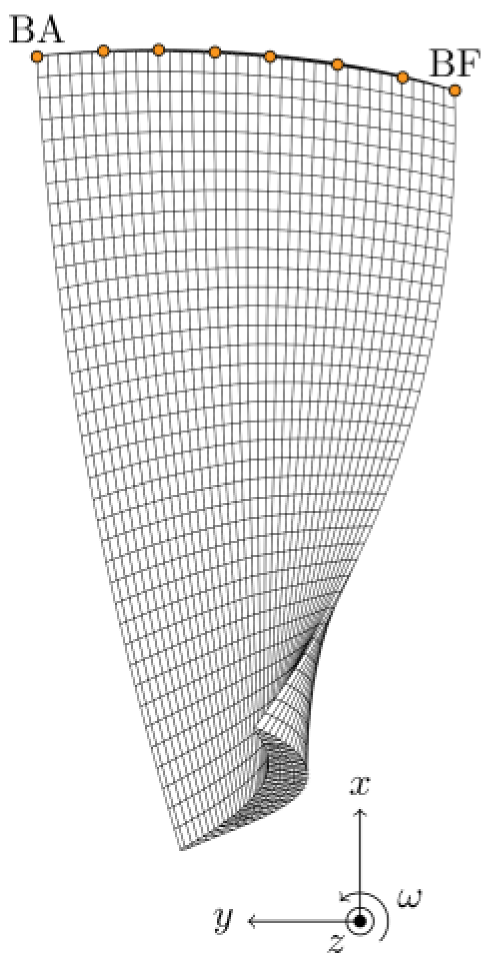
{\href{https://catalog.archives.gov/id/17500556}{https://catalog.archives.
gov/id/17500556}, 1980 (accessed 2021-09-09)}, % Fig. 2
}
```

# Maillage éléments finis

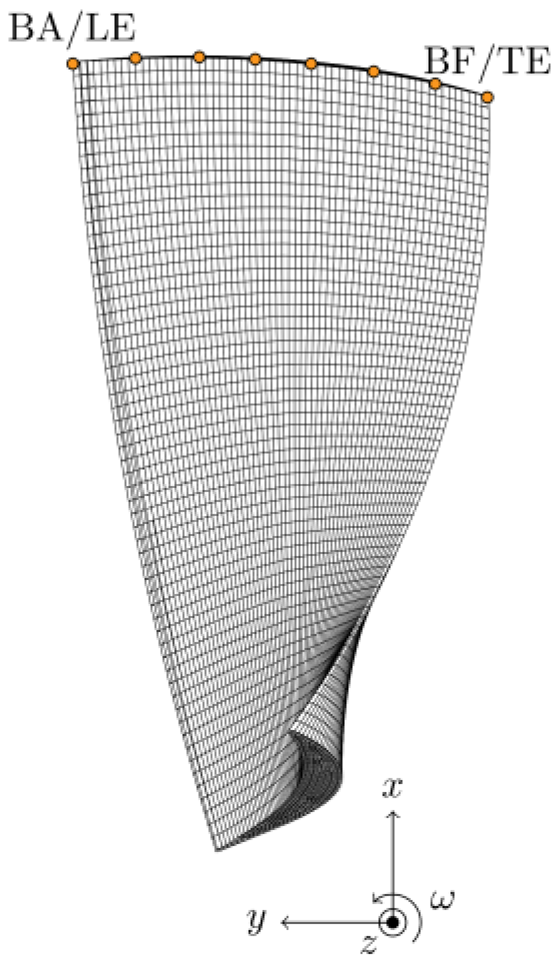
- Nombre de noeuds : 20393
- Nombre total d'éléments : 6232
- Nombre de degrés de liberté : 59964
- Type d'élément : pentaèdre quadratique




aperçu du maillage éléments finis (maillage grossier) - sources LaTeX

- Nombre de noeuds : 83393

- Nombre total d'éléments : 28560
- Nombre de degrés de liberté : 246960
- Type d'élément : quadratic pentahedron




aperçu du maillage éléments finis (maillage fin) - sources LaTeX

# Propriétés matériau

- Le matériau original du rotor 67 n'est pas défini dans le rapport de la NASA
- Propriétés considérées : alliage de titane Ti-6Al-4v :
  1. Module d'Young E = 108 GPa
  2. masse volumique $\rho$ = 4400 kg/m3
  3. coefficient de Poisson $\nu$ = 0,34
  4. limite élastique $\sigma_Y$ = 0,824 GPa
- Trois premiers modes prévus (noeuds de la base encastrés) pour le maillage grossier :
  1. 1F : 2040,7 rad/s / 324,8 Hz
  2. 2F : 6345,9 rad/s / 1010,0 Hz
  3. 1T : 10734,6 rad/s / 1708,5 Hz
- Trois premiers modes prévus (noeuds de la base encastrés) pour le maillage fin :
  1. 1B: 2039,7 rad/s / 324,6 Hz

2. 2B: 6340,6 rad/s / 1009,1 Hz
3. 1T: 10735,0 rad/s / 1708,5 Hz

# Références du laboratoire

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```

1. [a, b] Reid. «Performance of two-stage fan having low-aspect-ratio first-stage rotor blading » 1979. pdf
2. [a, b] Colaïtis. « Stratégie numérique pour l’analyse qualitative des interactions aube/carter » 2021. oai