Aalto University

Making Your Text Reader-friendly

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What do readers mean when they say:

Sentences are…

...hard to read?

...don't flow?

...unreadable?

Individual ***sentences*** are hard to understand

A series ***of sentences*** has no clear ***connections*** from sentence to sentence

Readers have expectations.

What are these expectations?

Task 1: Readers' Expectations

Which organizational pattern best follows your expectations?

This one?

***t*(*time*) = 15′, *T*(*temp*) = 28°; *t* = 0′, *T* = 25°; *t* = 6′, *T* = 29°;**

***t* = 3′, *T* = 27°; *t* = 12′, *T* = 32°; *t* = 9′, *T* = 31°; *t* = 8′, *T* = 30°**

Task 1: Readers' Expectations

Which o… …ectations?

After **6 minutes**, the temperature had risen to **29°C**

How about this o… … this on?

T(°C)	*t*(min)
25°	**0′**
27°	**3′**
29°	**6′**
31°	**9′**
32°	**12′**
28°	**15′**

t(min)	*T*(°C)
0′	**25°**
3′	**27°**
6′	**29°**
9′	**31°**
12′	**32°**
15′	**28°**

At **29°C**, the time was **6 min**

What are the units of information that you need to order in your texts?

Which of these units of information is the most important?

- **Noun** *(substantiivi)*

Countable → Tables usually have four legs.

Non-countable → Water can be dangerous.

Pronoun → We have an emergency.

”Head nouns” are underlined

- **Noun Phrase** *(noun-plus-modifier combination)*

A potential buyer has arrived.

The growing demand for asphalt is surprising.

The EU has established strict limitations on the size of plates that can be handled.

Task 2: Which version is easier to read? Why?

Version A

[1]For several decades, disabled and aged people have been served by wheelchairs. [2]The mobility, living quality and dignity have been improved for different people, environments and demands through the development of various wheelchairs. [3] Electric motors directly or indirectly installed on the wheel are the most conventional types of electric wheelchairs. [4]A high-speed, low-torque motor is used by indirectly-driven wheelchairs to drive the wheel through transmission and differential gears. [5]In contrast, torque motors installed on the hub of wheel with or without gears are used in directly-driven wheelchairs. [6]Therefore, there is usually a reduction in the overall efficiency of the indirectly-driven wheelchair, whereas a better overall efficiency is achieved by the wheelchair driven directly by hub-in motors. [7]However, the weight, inability to fold, high fuel consumption and small diameter of most of their driving wheels, which may cause unpleasant motion on a rough surface are problems of most directly-driven models.

Task 2: Which version is easier to read? Why?

Version B

[1]Wheelchairs have been serving disabled and aged people for several decades. [2]Various wheelchairs have been developed for different people, environments and demands in order to improve the mobility, living quality and dignity of the user. [3]Conventional electric wheelchairs consist of electric motors directly or indirectly installed on the wheel. [4]Indirectly-driven wheelchairs use a high-speed, low-torque motor to drive the wheel through transmission and differential gears. [5]In contrast, directly-driven wheelchairs use torque motors installed on the hub of wheel with or without gears. [6]Therefore, the overall efficiency of the indirectly-driven wheelchair is usually reduced due to transmission losses, whereas the wheelchair driven directly by hub-in motors has a better overall efficiency. [7]However, most of these directly-driven models are heavy, not foldable and fuel consuming, and most of their driving wheels have small diameter, which may cause unpleasant motion on a rough surface.

Task 2: Version B

[1]Wheelchairs … disabled and aged people for several decades.

[2]Various wheelchairs …to improve the mobility, ...

FAMILIAR NEW

[3]…electric wheelchairs …motors directly or indirectly installed …

FAMILIAR NEW

[4]Indirectly-driven wheelchairs...

FAMILIAR

[5]…directly-driven wheelchairs…

FAMILIAR

[6]…efficiency of the indirectly-driven wheelchair

FAMILIAR

[7]Most of these directly-driven models

FAMILIAR

Task 2: Version A

[1]…**disabled and aged people** … wheelchairs.

[2]The **mobility, living quality and dignity**… various wheelchairs

NEW FAMILIAR

[3] **Electric motors** … most conventional types of electric wheelchairs.

NEW FAMILIAR

[4]**A high-speed, low-torque motor**... indirectly-driven wheelchairs

NEW FAMILIAR

[5]**Torque motors** … in directly-driven wheelchairs.

NEW FAMILIAR

[6]**There**… a reduction

NEW FAMILIAR

[7]…**weight**, **inability to fold**, **high fuel consumption** and **small diameter**…

NEW

What is the optimal order for NPs?

How to make your text reader-friendly?

Three key principles:

1. **Put Given before New Information**
2. **Put "Topical" Information in Subject Position**
3. **Put "Light" Before "Heavy" NPs**

1. Put **Given** **before** **NEW** Information

What is GIVEN Info?

Concepts or objects that have already been ***discussed*** *or presumed to be* ***understood*** *from the context.*

What is NEW Info?

Concepts or objects that have ***not*** *already been* ***discussed*** *or presumed to be* ***known*** *from the context*

Topical progression

Three patterns for linking Given **information**

1. **Constant Topic**
2. **Step-wise Topic**
3. **Hypertopic**

Topical progression

1. Constant Topic

1. …**hydrogen** tanks are made from…
2. …**these** systems carry…
3. …**the** tank must have…
4. … **the** tanks must be made from….
5. **These** tanks are also quite large…

Topical progression

2. Step-wise Topic

[1] …organic waste …**shredder** and cut into **pieces**.

[2]The shredded **pieces** … **mixed** with manure and bio-sludge.

[3]The mixture … a **homogenization** process.

[4]The homogenized **biomass** … **pasteurization** tanks...

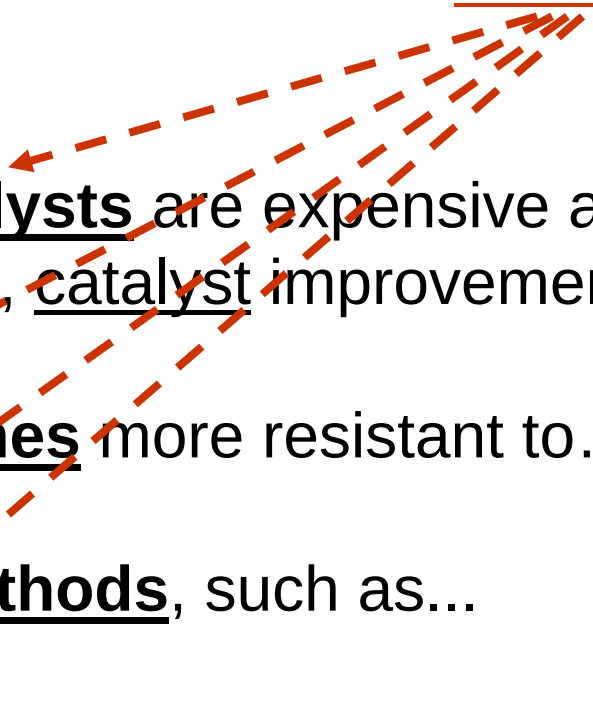
[5]The pasteurized **slurry** …methane **fermentation**...

[6]The fermentation process…

Topical progression

3. Hypertopic

[1]… PEM fuel cells face **several** challenges.



[2]**Platinum catalysts** are expensive and....

[3]For this reason, catalyst improvements…

[4]**New membranes** more resistant to…

[5]… **storage methods**, such as...

[6]**Cold starts** from frozen internal water

OPTIMAL ORDERING OF NOUN PHRASES

Three key principles:

1. **Put** Given **Information Before** New **Information**
2. **Put** Topical **Information in** "Subject" **Position**
3. **Put** "Light" **NPs Before** "Heavy" **NPs**

Put "Topical" info in the Subject

Unlike Finnish:

- **English sentences always have an agent or "doer"!**

Tänään Ø sataa lunta. *(**who** or **what** is raining?)*

It **is snowing today**. *(dummy **"it"**)*

Huoneessa Ø on kolme ikkunaa *(**what** has three windows?)*

There are three windows in the room. *(dummy **"there"**)*

or

The room has / contains three windows.

Put "Topical" info in the Subject

Unlike Finnish:

- **English has no "headless horsemen"!**

Kuvassa 2 Ø esitettään työmotivaatioon yhteydessä olevat tekijät.

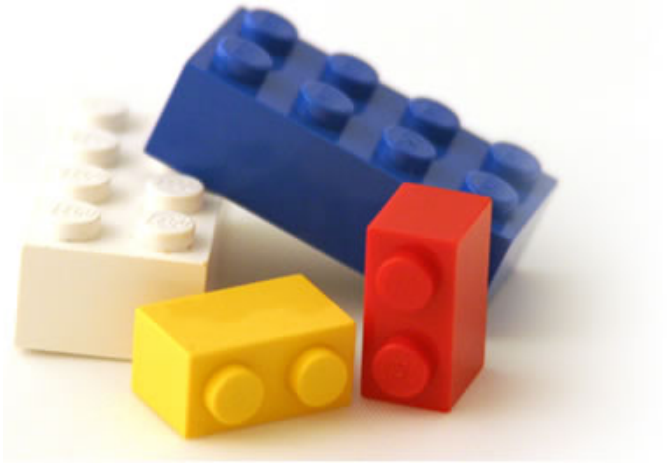
In figure 2 Ø is presented the factors associated with work motivation.

Figure 2 presents the factors associated with work motivation.

Which should go in subject position?

- NP that carries information most closely related to the **paragraph topic**!
- Aged people? Mobility? Weight? Motors? There? Wheelchairs?

OPTIMAL ORDERING OF NOUN PHRASES



Three key principles:

1. **Put** Given **Information Before** New **Information**
2. **Put** Topical **Information in** "Subject" **Position**
3. **Put** "Light" **NPs Before** "Heavy" **NPs**

Limits to Human Info Processing: 7±2 items

1 2 3 4 5 6 7 8 9 10 11

We have sent the research, development, and testing office in Chicago

12 13 14

Indirect object

a gas analyzer.

BETTER:

1 2 3 4 5 6 7 8 9 10

We have sent a gas analyzer to the research, development,

Direct object Object of Preposition

11 12 13 14 15

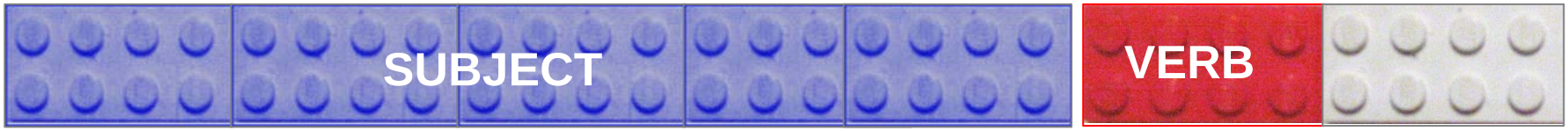
and testing office in Chicago

Balancing Information Elements

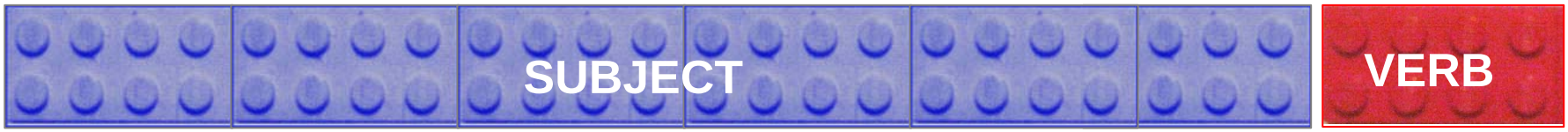
BEST!

ACCEPTABLE ***(if subject not too long)***

BAD!



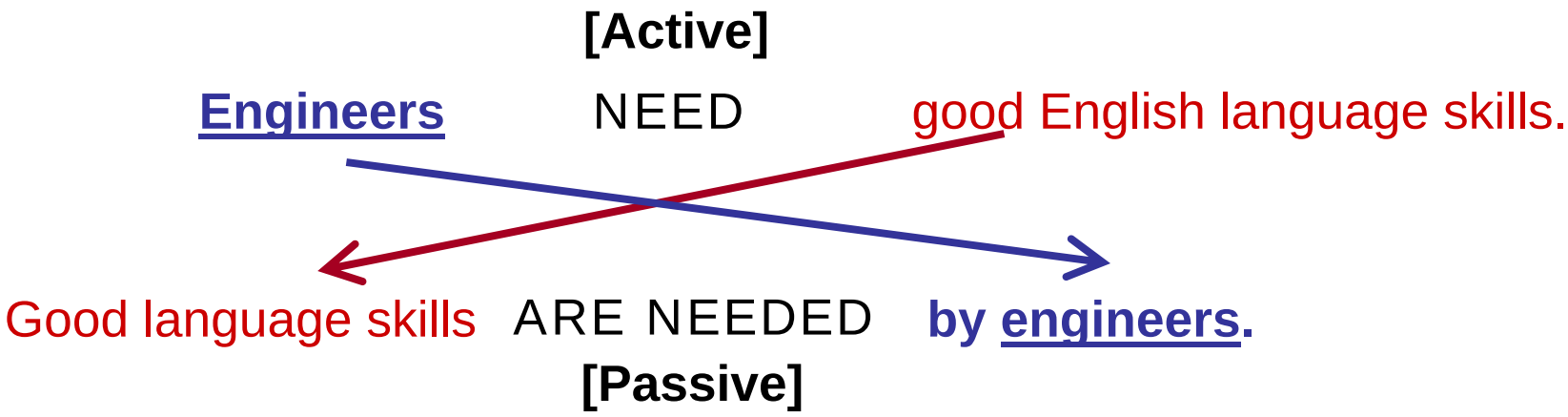
WORST!!



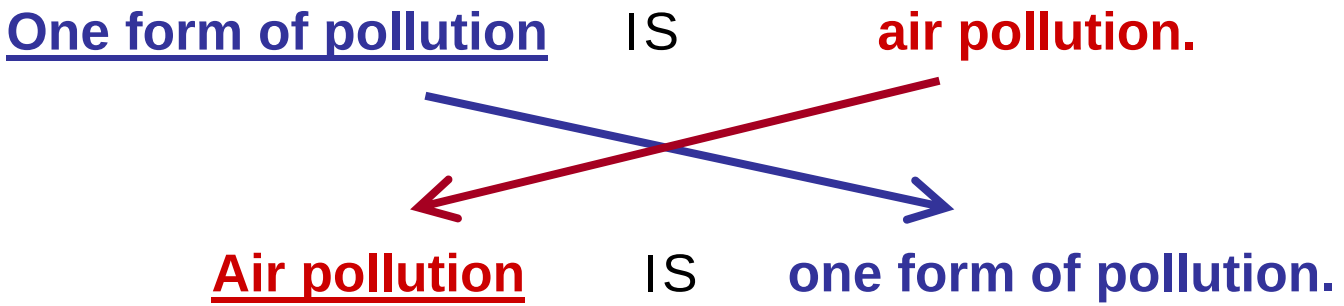
Strategies to reorder information

1. Passive-Active Shift
2. Equative Shift
3. Animate-Inanimate Shift
4. Personal-Impersonal Shift
5. Means-Purpose Shift
6. Introductory *“It”*
7. Existential *“There”*
8. Resultative –ing clause
9. Purpose clause
10. Split relative clause
11. Nominalization
12. When + -ing
13. Reorder clauses
14. Default subject

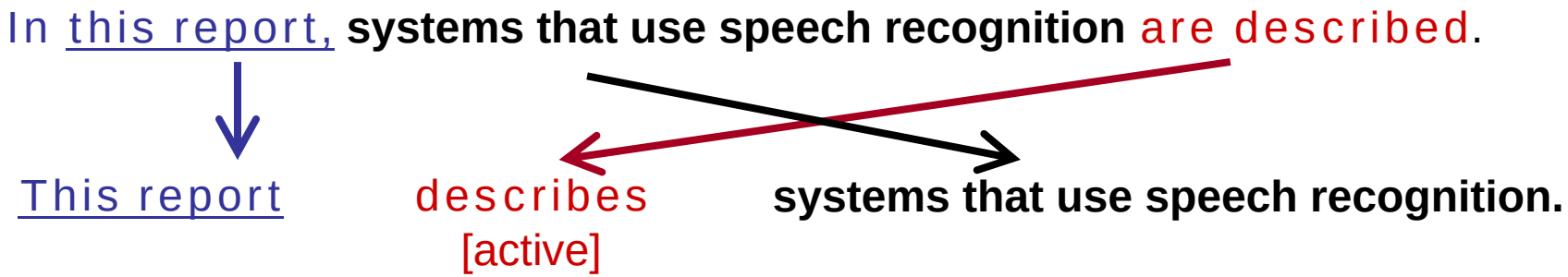
1. Passive-Active Alternation



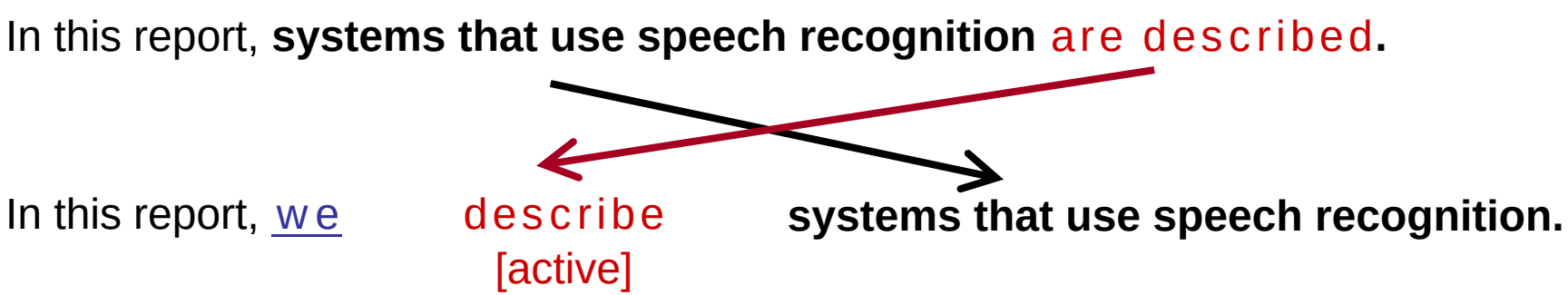
2. Equative Shift



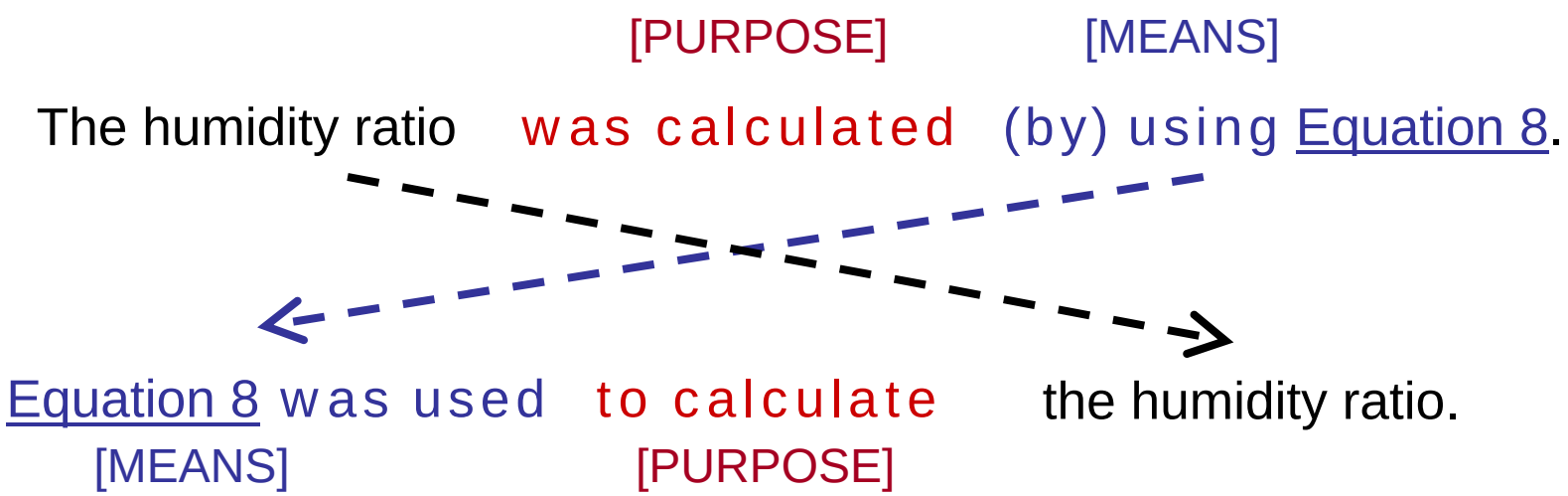
3. Animate-Inanimate Shift



4. Personal-Impersonal Shift

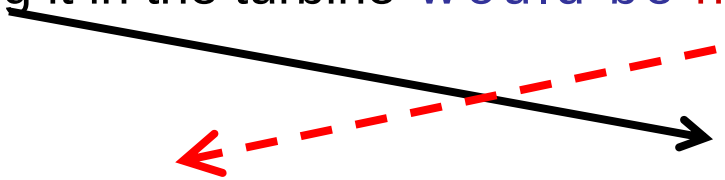


5. Means-Purpose Shift



6. Introductory *"It"* (dummy subject)

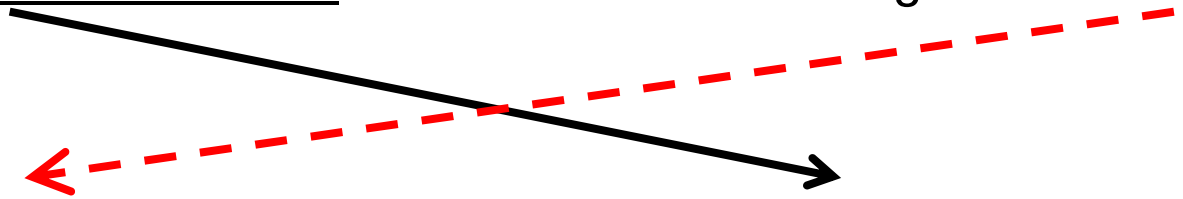
Adding heat and thus raising the temperature of the gas before expanding it in the turbine would be necessary.



IT would be necessary to add heat and thus raise the temperature of the gas before expanding it in the turbine.

7. Existential *"There"* (dummy subject)

A processor overhead associated with reconfiguration is available.



There is **a processor overhead** associated with reconfiguration.

Avoid overusing "*There is*"

Use the dummy "there" only when starting a new topic:

Once upon a time, *there was* a little girl called Little red riding hood.....

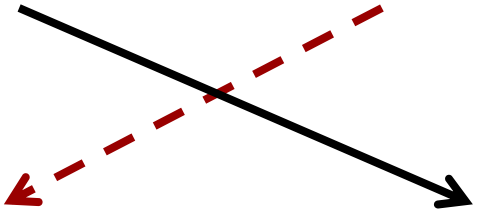
Dummy "there" often hides the action (verb) in a noun:

There are several important factors *that* / *which* must be considered in the design of a nuclear power plant.

Several important factors must be considered in the design of a nuclear power plant.

8. Resultative –ing (*so that* → *thus* + -ing)

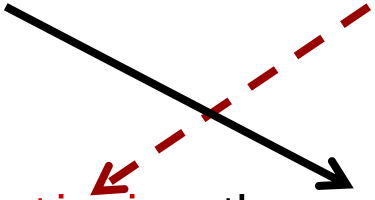
… forms an EM field, so that the vibration of the atoms is slowed.



The laser light forms an EM field, thus slowing the vibration of the atoms.

9. Purpose clause (*so that* ---> *to* infinitive)

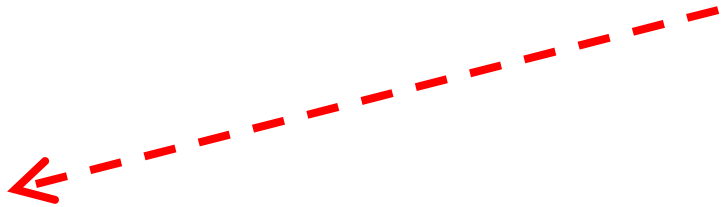
… algorithm clones a procedure, so that the code can be optimized.



...algorithm selectively clones a procedure to optimize the code.

10. Split relative clause (*that* / *which*)

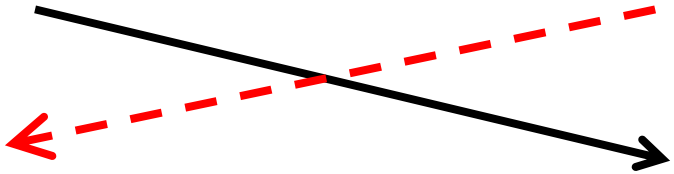
An algorithm that can facilitate fast image browsing is proposed.



An algorithm is proposed that can facilitate fast image browsing.

11. Nominalization (verb ---> noun)

Health experts fear that technology addiction will increase.

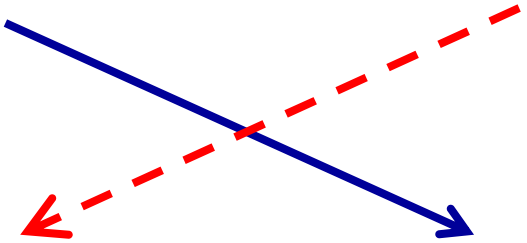


Health experts fear an increase in technology addiction.

[noun]

12. *When / before / after* + -ing

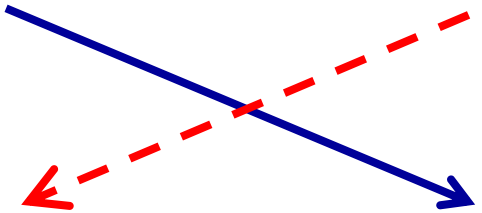
… is an important factor when a PMR solution is selected.



… is an important factor when selecting a PMR solution.

13. Reorder clauses

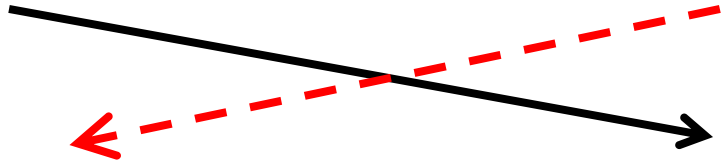
Various algorithms to generate testing automata have been developed.



Various algorithms have been developed to generate testing automata.

14. Find a Default Subject

Many gesture measuring devices for computer input have been devised.



Many researchers have devised gesture measuring devices for...

Strategies to reorder information

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Task 4

Revise the following top-heavy sentences to meet "light-heavy" criteria.

1. In a web-application, the content can be mashed by the client web browsers using client side web language such as JavaScript.

2. To circumvent the complexity problem, we develop a suboptimal mixture reduction method which proceeds in a sequential manner and approximates some of the required quantities using Gaussian approximations.

3. These two families of finite geometries allow the construction of four classes of LDPC codes.

4. Further work is required to improve the correlation.

   (**Strategy:** 9. So that →Purpose clause)

Task 4

Revise the following top-heavy sentences to meet "light-heavy" criteria.

5. An interview technique was employed that allowed the interviewee to explore the prototype, followed by questions to elicit the strengths and weaknesses of the prototype design.

6. Data mining is the process of sorting through large amounts of data and picking out relevant information.

7. In large-scale wireless sensor networks, complex perturbations can drive a network protocol into an arbitrary state, thus preventing manual control of the network.

   (**Strategy:** 8. Resultative '-ing')

Task 4

Revise the following top-heavy sentences to meet "light-heavy" criteria.

8. It is known that two nuclear processes are capable of releasing energy on a scale large enough to influence the personal and business lives of humans.

9. Some basic experiments must be conducted before beginning the simulation.

10. The participation of women has increased in all professional fields during the past decade.

11. Isotopes can be named by writing the mass number as a subscript to the left of the chemical symbol (e.g., 65Cu).

(**Strategy:** 5. Means-purpose Shift)

Task 4

Revise the following top-heavy sentences to meet "light-heavy" criteria.

12. The next section briefly describes the verified interconnection scheme.

13. Hydrogen can be produced by chemical processes from fossil fuels, by hydrolysis of water with oxygen as a by-product, or by thermal decomposition.

14. The basic approach of reusability is to configure and specialize pre-existing software components into viable application systems.

15. An effective solution must consider the connection between the concept of a hyperlink and the navigation issues common to all forms of nonlinear media.

    (**Strategy:** 14. Find a Default subject)

The CARS Model for research introductions

MOVE 1: *Establishing a Territory*

STEP A: Claiming centrality

STEP B: Making topic generalizations

STEP C: Reviewing items of previous research

SITUATION

MOVE 2: *Establishing a Niche*

STEP A: Indicating a Gap

STEP B: Counter-claiming

PROBLEM

MOVE 3: *Occupying the Niche*

STEP A: Outlining purposes

STEP B: Announcing main findings

STEP C: Evaluating the value of the research

SOLUTION

The CARS Model for research introductions

MOVE 1: *Establishing a Territory*

STEP A: Claiming centrality

STEP B: Making topic generalizations

STEP C: Reviewing items of previous research

MOVE 2: *Establishing a Niche*

STEP A: Indicating a Gap

STEP B: Counter-claiming

MOVE 3: *Occupying the Niche*

STEP A: Outlining purposes

STEP B: Announcing main findings

STEP C: **Evaluating the value of the research**

STEP D: Indicating structure of the article

SITUATION

PROBLEM

SOLUTION

EVALUATION

Introduction 1

Design, analysis and realisation of a high-performance magnetic gear

K. Atallah, S.D. Calverley and D. Howe

IEE Proceedings-Electrical Power Applications, Vol. 151, No. 2,
March 2004

Language expressing this move?

Move 1-A: Claiming centrality

[1]Mechanical gearboxes are used extensively to match the operating speed of prime-movers to the requirements of their loads, both for increasing the rotational speed (e.g. wind-powered generators)and decreasing the speed (e.g. electric ship propulsion), since it is usually more cost and weight effective to employ a high-speed electrical machine together with a gearbox to transform speed and torque. [2]However, although high system torque densities can then be achieved, gearboxes usually require lubrication and cooling, whilst noise, vibration and reliability can be significant issues. [3]Magnetic gears offer several potential advantages, such as …

Language expressing this move?

Move 1-A: Claiming centrality

Move 2-B: Counter-claiming

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Language expressing this move?

Move 1-A: Claiming centrality

Move 2-B: Counter-claiming

Move 1-B: Topic generalizatio

[1]Mechanical gearboxes are used extensively to match the operating speed of prime-movers to the requirements of their loads, both for increasing the rotational speed (e.g. wind-powered generators)and decreasing the speed (e.g. electric ship propulsion), since it is usually more cost and weight effective to employ a high-speed electrical machine together with a gearbox to transform speed and torque. [2]However, although high system torque densities can then be achieved, gearboxes usually require lubrication and cooling, whilst noise, vibration and reliability can be significant issues. [3]Magnetic gears offer several potential advantages, such as …

Language expressing this move?

Move 2-A: Indicating a Gap

[4]However, despite these advantages magnetic gears have received relatively little attention, probably because of the relative complexity and poor torque density of the magnetic circuits which have been proposed. [5]A magnetic gear topology which employed the variable reluctance principle to transmit torque and which had a much improved utilisation of the magnetic circuit compared to previous topologies, was proposed [1]. [6]However, its torque transmission capability and efficiency were less than 5 kNm/m^3 and 35%, respectively. [7]Magnetic gears which employ high energy permanent magnets have also been proposed and analysed [2, 3]. [8]However, they are all characterised by a poor magnetic circuit, as illustrated in Fig. 1, in which, at any instant, only a fraction of the permanent magnets contribute to torque transmission.

Language expressing this move?

Move 2-A: Indicating a Gap

Move 1-C: Previous Research

[4]However, despite these advantages magnetic gears have received relatively little attention, probably because of the relative complexity and poor torque density of the magnetic circuits which have been proposed. [5]A magnetic gear topology which employed the variable reluctance principle to transmit torque and which had a much improved utilisation of the magnetic circuit compared to previous topologies, was proposed [1]. [6]However, its torque transmission capability and efficiency were less than 5 kNm/m^3 and 35%, respectively. [7]Magnetic gears which employ high energy permanent magnets have also been proposed and analysed [2, 3]. [8]However, they are all characterised by a poor magnetic circuit, as illustrated in Fig. 1, in which, at any instant, only a fraction of the permanent magnets contribute to torque transmission.

Language expressing this move?

Move 2-A: Indicating a Gap

Move 1-C: Previous Research

Move 2-B: Counter-claiming

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Language expressing this move?

Move 2-A: Indicating a Gap

Move 1-C: Previous Research

Move 2-B: Counter-claiming

Move 1-C: Previous Research

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Language expressing this move?

Move 2-B: Counter-claiming

Move 1-C: Previous Research

Move 2-B: Counter-claiming

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Language expressing this move?

Move 2-B: Counter-claiming

Move 1-C: Previous Research

Move 2-B: Counter-claiming

Move 2: Positive Justification

[6]However, its torque transmission capability and efficiency were less than 5 kNm/m^3 and 35%, respectively. [7]Magnetic gears which employ high energy permanent magnets have also been proposed and analysed [2, 3]. [8]However, they are all characterised by a poor magnetic circuit, as illustrated in Fig. 1, in which, at any instant, only a fraction of the permanent magnets contribute to torque transmission. [9]Hence, their specific torque capability and efficiency are also low. [10]Thus, for applications in which mechanical gearing cannot be accommodated, direct electrical drives are employed, transverse-field machines offering the highest torque density, albeit operating at a relatively low power factor.

Language expressing this move?

Move 3-A:
Outlining Purpose

[11]This paper describes the design and performance of the magnetic gear topology shown in Fig. 2, whose principle of operation was introduced in [4]. [12]It employs rare-earth permanent magnets on both the inner rotor and the outer rotor, and has ferromagnetic pole-pieces between the two rotors. [13]However, unlike the topology shown in Fig. 1, all the permanent magnets contribute to torque transmission. [14]Indeed, simulation and experimental studies have shown that such a gear has a transmitted torque density capability which is comparable with that of two- and three-stage helical gearboxes, viz. 50–150kNm/m^3. [15]Thus, when combined with the conventional topology of a permanent magnet brushless machine, such a magnetic gear could offer significant advantages in applications as diverse as embedded motor/generator units in 'more-electric' aircraft engines, electric ship propulsion systems, wind-powered generation, etc.

Aalto University

Language expressing this move?

Move 3-A: Outlining Purpose

Move 3-B: Main

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Language expressing this move?

Move 3-A: Outlining Purpose

Move 3-B: Main

Move 3-C: Evaluating value

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Aalto University

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Move 3-A: Outlining Purpose

Move 3-B: Main

Move 3-C: Evaluating value

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Move 3-A: **Outlining Purpose**

Move 3-B: Main

Move 3-C: Evaluating value

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Is "etc." necessary?

Introduction 2

Simple position sensorless starting method for brushless DC motor

P. Damodharan, R. Sandeep and K. Vasudevan

IET Electric Power Applications, Jan. 2008, Vol. 2 Issue 1, p49-55.

The CARS Model for research introductions

MOVE 1: *Establishing a Territory*

STEP A: Claiming centrality

STEP B: Making topic generalizations

STEP C: Reviewing items of previous research

SITUATION

MOVE 2: *Establishing a Niche*

STEP B: Indicating a Gap

PROBLEM

MOVE 3: *Occupying the Niche*

STEP A: Outlining purposes

STEP B: Announcing main findings

STEP C: Evaluating the value of the research

STEP D: Indicating structure of the article

SOLUTION

Language expressing this move?

Move 1-A: Claiming centrality

[1] Permanent magnet (PM) motors have been widely used in a variety of applications in industrial automation and consumer appliances because of their higher efficiency and power density. [2] Two major categories of PM motors [1, 2] based on their back-EMF waveform shapes are PMAC synchronous motors (PMAC or PMSM) with sinusoidal back-EMF and brushless DC motors (BLDC) with trapezoidal back-EMF. [3] A PMSM motor is typically excited by three-phase sinusoidal currents, whereas a BLDC motor is excited by three-phase rectangular currents. [4] PM motors are usually powered through conventional three-phase voltage source inverters.

Language expressing this move?

Move 1-A: Claiming centrality

Move 1-B: Topic generalizatio

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Language expressing this move?

Move 1-B: Topic generalizatio

[5] PM motor drives require rotor position information to properly perform switching of the DC supply to the three-phase windings of the stator in correct sequence by a control circuit. [6] PMSM motors require a constant supply of rotor position information to develop a sinusoidal current in phase with the back-EMF. [7] Thus, a position sensor with a high resolution such as a resolver or shaft encoder is typically used, whereas for BLDC motor, only six discrete rotor position informations per electrical cycle are needed to feed a rectangular current in phase with the back-EMF. [8] Therefore, low-cost sensors such as Hall-effect switches are usually used.

Language expressing this move?

Move 2-B: Counter-claiming

[9] However, it is a well known fact that these sensors have a great number of drawbacks that increase the cost of the motor and need special mechanical arrangements to be mounted. [10] Further, Hall sensors are temperature-sensitive and hence limit the operation of the motor. [11]They could reduce the system reliability because of the extra components and wiring. [12]Furthermore, sensorless control is the only reliable way to operate the motor for applications in harsh environments. [13] There has been much interest in position sensorless control of BLDC motor, since many of the drawbacks can be eliminated or reduced with position sensorless operation.

Language expressing this move?

Move 2-B: Counter-claiming

Move 2: Positive Justification

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Language expressing this move?

Move 1-C: Previous Research

[14]One approach to sensorless operation is to use the induced phase back-EMF information. [15]When the motor is running, back-EMF is induced in the stator coils and can be used to estimate the position of the rotor [3–11]. [16]However, when the motor is at standstill, there is no back-EMF induced in the coil, thus requiring a startup algorithm or an initial rotor position detection method to start the motor reliably from standstill up to a minimum speed at which the conventional position sensorless control methods based on back-EMF information could take over.

Language expressing this move?

Move 1-C: Previous Research

Move 2-B: Counter-claiming

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Language expressing this move?

Move 1-C: Previous Research

[17]A simple startup algorithm [3–8] is to align the rotor to a predetermined position (known as prepositioning) by energising two phases of the motor. [18]The rotor may then be accelerated according to given firing sequences with decreasing time intervals. [19]It is a usual practice to make the initial acceleration under open-loop control using a ramped frequency signal, also known as stepping control, the parameters of which must be chosen to match drive and load parameters. [20]As explained in [4], in this approach, the excitation sequence of the phases is fixed in an open loop. [21]The excitation frequency starts at a certain level and is increased at a certain rate so as to force the rotor to follow. [22]This is done until sufficient back-EMF is available for detection.

Language expressing this move?

Move 2-B: Counter-claiming

[23]The drawback of this procedure is that the rotor may not follow the excitation sequence always and may tend to oscillate or reverse rotation and thus cause a starting failure [12].
[24]To avoid this, Shao et al. [9], experimentally tune the ramp-up rate of the excitation frequency.

[25]Ogasawara and Akagi [10] advance the switching pattern by 120 electrical degrees after prepositioning, which subsequently allows their sensorless method to take over. [26]However, the sensorless operation in [10] requires the detection of current flow through the free-wheeling diodes, which in turn requires elaborate circuitry.

Language expressing this move?

Move 2-B: Counter-claiming

Move 1-C: Previous Research

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Move 2-B: Counter-claiming

Move 1-C: Previous Research

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Language expressing this move?

Move 2-B: Counter-claiming

Move 1-C: Previous Research

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Language expressing this move?

Move 2-B: Counter-claiming

Move 1-C: Previous Research

Move 2-B: Counter-claiming

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Language expressing this move?

Move 1-C: Previous Research

[29]Another approach found in the literature [12–14] is to estimate the rotor position by using the inductance variation because of the magnet position and an impressed stator current. [30]A suitable sequence of voltage pulses is applied to the stator windings at standstill and the evaluation of the rate of change of current leads to the rotor position estimation. [31]Even though these methods seem to be robust in detecting the rotor position, their precision relies on the accuracy of the measurements used and the exactness of the relations used for their processing [15]. [32]Moreover, these methods are quite complex and relatively difficult to implement.

Language expressing this move?

Move 1-C: Previous Research

Move 2-B: Counter-claiming

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Move 3-A: Outlining Purpose

[33]This paper proposes a simple and reliable method to detect the back-EMF zero crossings. [34]It is further shown in the paper that this method can be used to start the machine as well, once the initial rotational movement is established. [35]In this work, the rotor is first brought to a known position through a prepositioning step. [36]Subsequent rotation of the rotor is achieved by a 120 electrical degree triggering followed by a sequential triggering of the devices based on zero crossings of the back-EMF. [37]Unlike the method of described in [11], this scheme is easy to implement, as it involves no derivative operations. [38]Both simulation and hardware implementation results are provided to verify the efficacy of this starting method. [39]This paper is organised as follows. [40]Section 2 describes the proposed back-EMF zero crossing estimation method and the startup procedure. [41]Section 3 demonstrates the

Language expressing this move?

Move 3-A: Outlining Purpose

Move 3-C: Evaluating value

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Move 3-A: Outlining Purpose

Move 3-C: Evaluating value

Move 3-B: Main findings (procedure)

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Move 3-C: Evaluating value

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Move 3-C: Evaluating value

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Language expressing this move?

Move 3-C: Evaluating value

Move 3-D: Indicating Structure

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